JOURNAL

OF THE

AMERICAN CHEMICAL SOCIETY.

VOL. VII.—NO. 10.

DECEMBER,

1885.

COMMITTEE ON PAPERS AND PUBLICATIONS:

J. H. STEBBINS, JR.,

A. R. LEEDS,

A. A. BRENEMAN, Editor.

ABSTRACTORS:

F. P. VENABLE, W. RUPP,

J. H. STEBBINS, JR., M. LIEBSCHÜTZ.

CONTENTS:

	Page.
Proceedings, December meeting	259
I. A Chemical, Biological and Experimental Inquiry into the present and proposed future water supply of the City of Albany; By Dr. Albert R. Leeds	261
Abstracts from Chemical Journals:	
General and Inorganic Chemistry	283
Organic Chemistry	288
Analytical Chemistry	290
Abstracts of American Patents relating to Chemistry	297
Errata, Volume VII	302
Index " "	
Title page " "	
Officers for 1886	
List of Members	

PUBLISHED MONTHLY.

NEW YORK:

JOHN POLHEMUS,

102 Nassau Street.

1885.

The **Journal of the American Chemical Society** appears monthly, except during July and August. It will contain all papers read before the Society, as well as abstracts from American and Foreign Journals, and a list of American Patents relating to Chemical Industries.

The Price of Subscription is $5.00 per year, in advance.

The Meeting Room and Library of the Society are at Room 1, University Building, Washington Square, New York.

The Regular Monthly Meeting is held on the first Friday of every month, at 8 P. M.

Corresponding Secretary:

P. CASAMAJOR, Care of Havemeyer & Elder, Brooklyn, E. D.

Treasurer:

T. O'CONNOR SLOANE, 119 Pearl St., New York.

The Library will be open to Members regularly on Fridays, from 6 to 10 P. M., and at any other time on presenting to the Janitor of the University Building a ticket, which can be obtained of the Librarian.

Back numbers of the Journal are sold to Members at $3.00, to others at $5.00, per volume. Apply to the Librarian

W. RUPP, 117 Pearl St., New York.

The Committee on Papers and Publications respectfully call attention to the resolutions of the Society, requiring that papers be submitted to the Committee before being read.

Members who cannot be present at the meetings, are requested to send their papers in care of the Committee, who can guarantee prompt publication of all articles accepted.

Authors will be furnished, gratis, with 20 reprints of each article published in the Journal, if application for the same be made when the article is sent.

Members are requested to notify the Committee of any change of address, or failure in the delivery of the Journal. All communications relating to the Journal should be addressed in care of the Editor

A. A. BRENEMAN, 97 Water St., New York.

PROCEEDINGS OF THE AMERICAN CHEMICAL SOCIETY.

REGULAR MEETING, December 4th, 1885.

Dr. A. R. Leeds in the chair.

The minutes of the meeting of November 6th were read and approved.

The Treasurer's Report was read, and Messrs. Alsberg and Casamajor were appointed a committee to audit the Treasurer's accounts.

The Committee on Papers and Publications reported, through Prof. Breneman that the Journal needs more co-operation from members in the preparation of abstracts.

Messrs. Liebschütz and Gladding were appointed tellers for the election of officers and committees for 1886.

The following officers were then elected to serve during the year 1886:

President:

A. B. PRESCOTT.

Vice-Presidents:

A. R. LEEDS,
A. A. BRENEMAN,
H. ENDEMANN,
T. G. WORMLEY,
H. B. NASON,
T. S. HUNT.

Corresponding Secretary:

P. CASAMAJOR.

Recording Secretary:

C. E. MUNSELL.

Treasurer:

T. O'C. SLOANE.

Librarian:

WILLIAM RUPP.

Curators:

M. LIEBSCHUTZ, J. P. BATTERSHALL, O. H. KRAUSE.

Committee on Papers and Publications:

JAS. H. STEBBINS, JR., A. A. BRENEMAN, A. R. LEEDS.

Committee on Nominations:

J. B. MACKINTOSH, M. E. WALDSTEIN, A. C. HALE,
R. W. MOORE, A. P. HALLOCK.

Board of Directors:

A. R. LEEDS,
A. A. BRENEMAN,
H. ENDEMANN,
} *Three Local Vice-Presidents.*

P. CASAMAJOR,
C. E. MUNSELL,
T. O'C. SLOANE,
WM. RUPP.
E. WALLER,
C. F. CHANDLER,
M. ALSBERG,
JAS. H. STEBBINS, JR.,
M. E. WALDSTEIN,
T. S. GLADDING.

Milton W. Grovesteen, of 430 West 23d street, New York, was elected a regular member.

Walter B. Price, of 26 Broadway, New York, was proposed for membership.

The following paper was then read:

Chemical, experimental, and biological inquiries in connection with the present and proposed future water supply of the city of Albany, by Albert R. Leeds, Ph. D.

The following papers were announced for the next meeting on January 8th, 1886:

Report of Committee on Nomenclature.

A Platinum Filter for Filtration on Dr. Carmichael's Plan; by P. Casamajor.

Some contributions to the Study of New York City Water; by A. A. Breneman, S. B.

The meeting was then adjourned.

C. E. MUNSELL,
Recording Secretary.

A CHEMICAL, BIOLOGICAL AND EXPERIMENTAL INQUIRY INTO THE PRESENT AND PROPOSED FUTURE WATER SUPPLY OF THE CITY OF ALBANY.

By Dr. Albert R. Leeds.

In the Spring of the present year, the Legislature of the State of New York was moved, by the frequent outbursts of popular indignation in Albany, with regard to the quality of its water supply, to create a Special Water Commission. And, inasmuch, as the investigations which I found necessary to make, as chemist to this commission, caused me to travel over certain new ground, I have thought it might prove of interest to the profession to put certain of the results on record in this journal. Fortunately the wording of the Act appointing the commission not only gave, but also encouraged considerable latitude of inquiry, for it directed that two objects should be kept in view :—

1st. Due inquiry into the available sources of supply of pure and wholesome water.

2d. If the present water supply proved on investigation to be the best available, then as to what, if any, method could be adopted for its improvement, or if possible, its purification.

In the conduct of the first branch of the investigation, I had occasion to examine the following possible sources of supply :—

1st. Certain lakes and water courses east of the Hudson, but in the immediate vicinity of Albany.

2d. Driven wells on the hills west of Albany, and driven wells located upon the flats lying along the river, north and south of the city.

3d. Various points upon the Hudson River, such as Waterford, situated above the influx of sewage from the city of Troy, and as many other points between Troy and Albany as would be necessary to investigate the question of the self-purification of the stream and the advisability of shifting the location of the mouth of the intake of the present pumping station to such other point as might be shown to afford better water.

4th. The Mohawk River above and below the falls.

With regard to the second branch of the inquiry, I was authorized by the commission to institute experiments upon the relative advantages of the following methods :—

1st. Purification by artificial oxidation by gaseous oxidants, and more specially oxygen, air and ozone, at ordinary atmospheric pressures and temperatures, or at increased pressures and temperatures.

2d. Purification by the use of solid substances, acting either as oxidants or precipitants or both.

3d. Combinations of the two preceding, in various orders and under various conditions of temperature and pressure.

4th. Purification by natural and artificial filtration, according to the many methods either hitherto in use, or such as might prove themselves peculiarly adapted to the environment of the Albany water supply.

5th. Combinations of the first three, or purification proper, with the fourth, the object being primarily to render innocuous noxious matter, both such as exists diffused in a state of solution, and particulate in the form of micro organisms ; and secondarily, to remove the *débris* of this noxious matter, and all suspended substances as well, by effective filtration.

In the conduct of the experiments falling under the five heads above enumerated, I was prevented by the necessity of performing a great number of analyses upon the various proposed sources of supply, and the limited time allowed by the Legislature to the commission before bringing in its final report, from prosecuting them to the desired point. I am able, therefore, to give only certain results in this place, and shall postpone the presentation of the remainder until they are worked out in connection with the proposed new water supply of the city of Philadelphia.

The methods of investigation made use of in connection with the Albany water supply, might be summarized under three classes :

A. Analytical.
B. Experimental.
C. Biological.

I. Analytical Data.

The analytical data established in the case of each sample, were the free and albuminoid ammonia, the nitrous and nitric acid, the oxygen required to oxidize organic matters as determined by permanganate at the boiling point, and also by means of photo-chemical measurement, chlorine, hardness, total solids dried at 110°, fixed matter at low redness, volatile matter at low redness, and the dissolved oxygen, carbon dioxide, and nitrogen gases.

The nitric acid was determined by reduction to nitric oxide and endiometric measurement of the evolved gas. The original method for photo-chemical measurement of the oxygen required to oxidize organic matter, as stated in *The Philosophical Magazine*, has been modified in its application to more than 500 samples of waters, and the improved method and results I hope to find leisure to communicate in a subsequent article, together with the apparatus employed for the endiometric measurement of dissolved gases.

In the five tables which follow, are given:

I. A comparison of the waters of certain lakes and streams of the hill country east of the Hudson River, with the water taken from the Hudson at the present Albany pumping station. This comparison was made in deference to the opinions of those who thought that waters taken from elevated points in a mountainous district must necessarily be purer than that taken from a great stream flowing at a lower level.

II. Comparison of the water from a number of driven wells located on the hills west of Albany, and upon the alluvial flats lying along the Hudson River immediately north of the city, with the waters of the Hudson River.

III. A comparison of the waters of the Hudson River itself from a point above the influx of the sewage of Troy to the Albany pumping station, a distance of about seven miles.

IV. A comparison of the waters of the Mohawk River above and below the falls with those of the Hudson River taken directly at the intake, as delivered directly from the faucet at the City Hall, and as delivered from a commercial sand and charcoal filter located at the same point.

V. A comparison of the mineral constituents in the waters taken from two mountain lakes, a mountain stream, and a driven well in the hill country, with the waters of the Hudson River and the Mohawk River.

TABLE I.—LAKES IN RENSSELAER COUNTY WITH ALBANY PUMPING STATION FOR COMPARISON.

Laboratory Number	826	827	828	829	830	837
Special Number	I.	II.	III.	IV.	V.	VI.
Location	Snyder's Lake—Middle.	Sand Lake—Middle.	Poestenkill River at East Poestenkill.	Dykeing Pond.	Pump-well of Pumping Station at Albany.	Pump-well of Pumping Station at Albany.
Date	Sept. 4th.	Sept. 4th.	Sept. 4th.	Sept. 5th.	Sept. 5th.	Sept. 16th.
Color	0	0	1.25	1.75	4.00	2.00
Taste	Earthy.	Slight.	Peaty.	Slightly marshy	Pleasant.	Pleasant.
Smell	None.	None.	Peaty.	None.	Faint.	Slight.
FREE AMMONIA—						
Parts per 100,000	0.002	0.009	0.011	0.014	0.004	0.011
Grains per gallon	0.0012	0.0052	0.0064	0.0082	0.0023	0.0064
ALBUMINOID AMMONIA—						
Parts per 100,000	0.037	0.029	0.032	0.026	0.019	0.023
Grains per gallon	0.0215	0.0169	0.0186	0.0152	0.0111	0.0134
NITROUS ACID—						
Parts per 100,000	None.	None.	None.	Trace.	Trace.	None.
Grains per gallon	None.	None.	None.	Trace.	Trace.	None.
NITRIC ACID—						
Parts per 100,000	0.147	0.189	0.27	0.90	0.147	0.09
Grains per gallon	0.0857	0.11	0.157	0.524	0.0857	0.052
OXYGEN REQUIRED TO OXIDIZE ORGANIC MATTERS [PERMANGANATE]—						
Parts per 100,000	0.32	0.25	1.90	0.60	1.20	0.74
Grains per gallon	0.1866	0.145	1.108	0.35	0.70	0.43
OXYGEN REQUIRED TO OXIDIZE ORGANIC MATTERS [SILVER]—						
Parts per 100,000	0.49	0.32	0.85	0.75	0.56	0.523
Grains per gallon	0.285	0.187	0.496	0.437	0.326	0.304
CHLORINE—						
Parts per 100,000	0.30	0.21	0.34	0.34	0.35	0.375
Grains per gallon	0.175	0.122	0.198	0.198	0.204	0.218
HARDNESS—						
Parts per 100,000	3.7	2.3	1.80	2.50	4.8	4.7
Grains per gallon	2.15	1.34	1.05	1.45	2.8	2.74
TOTAL SOLIDS—						
Parts per 100,000	7.40	3.7	5.5	6.90	10.7	11.0
Grains per gallon	4.315	2.157	3.2	4.02	6.23	6.41
MINERAL MATTER—						
Parts per 100,000	3.70	2.0	1.5	1.60	7.9	7.0
Grains per gallon	2.157	1.166	0.874	0.933	4.6	4.08
ORGANIC AND VOLATILE MATTER—						
Parts per 100,000	3.70	1.70	4.0	5.3	2.8	4.0
Grains per gallon	2.157	0.99	2.33	3.09	1.63	2.33
DISSOLVED GASES BY VOLUME—						
Oxygen, cubic centimeters per liter	5.02	5.57	5.55	3.96	5.24	3.83
Carbonic dioxide, cubic centimeters per liter	1.48	1.61	0.86	6.56	1.29	2.72
Nitrogen " " "	12.20	12.02	12.59	12.02	12.22	12.58
Total Gases, cubic centimeters per liter	18.70	19.20	19.00	22.54	18.75	19.07

TABLE II.—DRIVEN WELLS WITH ALBANY PUMPING STATION FOR COMPARISON.

Laboratory Number	838	868	869	871	873	870
Special Number	VII.	VIII.	IX.	X.	XI.	XII.
Location					Well No. 5, on	Pump Well of

Nitrogen " " "						
Total Gases, cubic centimeters per liter	18.70	19.30	19.00	22.54	18.75	19.07

TABLE II.—DRIVEN WELLS WITH ALBANY PUMPING STATION FOR COMPARISON.

	838 VII. Well on Blessing Farm.	868 VIII. Well No. 1 on Three Hill Farm	869 IX. Well No. 2, on Three Hill Farm	871 X. Well on Flats, Troy Road.	872 XI. Well No. 5, on Dr. T. Helmes' Farm.	870 XII. Pump Well of Alb'ny Pumping Station.
Laboratory Number						
Special Number						
Location						
Date	Sept. 17th.	Oct. 19th.	Oct. 19th.	Oct. 29th.	Oct. 19th.	Oct. 19th.
Color	0.5	0.25	0	2.0	0	2.0
Taste	Unpleasant.	Pleasant.	Pleasant.	Pleasant.	Pleasant.	Pleasant.
Smell	None.	None.	Slightly vegtble	Slightly Unplnt	None.	Slightly Unplnt
FREE AMMONIA—						
Parts per 100,000	0.013	0.012	0.017	0.002	0.024	0.004
Grains per gallon	0.0076	0.007	0.01	0.0012	0.014	0.0023
ALBUMINOID AMMONIA—						
Parts per 100,000	0.011	0.015	0.01	0.011	0.01	0.017
Grains per gallon	0.0064	0.0087	0.0058	0.0064	0.0058	0.01
NITROUS ACID—						
Parts per 100,000	None.	None.	None.	None.	None.	None.
Grains per gallon	None.	None.	None.	None.	None.	None.
NITRIC ACID—						
Parts per 100,000	0.20	0.09	0.09	0.088	0.1	0.15
Grains per gallon	0.1166	0.052	0.052	0.0512	0.058	0.087
OXYGEN REQUIRED TO OXYDIZE ORGANIC MATTER [PERMANGANATE]—						
Parts per 100,000	0.034	0.15	0.095	0.12	0.10	0.71
Grains per gallon	0.0198	0.087	0.055	0.07	0.058	0.41
OXYGEN REQUIRED TO OXYDIZE ORGANIC MATTER [SILVER]—						
Parts per 100,000	0.523	0.41	0.52	0.37	0.56	0.57
Grains per gallon	0.304	0.238	0.302	0.215	0.326	0.332
CHLORINE—						
Parts per 100,000	2.95	3.0	3.25	0.525	2.000	5.25
Grains per gallon	1.72	1.75	1.90	0.305	1.166	3.05
HARDNESS—						
Parts per 100,000	10.30	11.0	11.10	11.95	2.50	8.29
Grains per gallon	6.00	6.41	6.45	6.96	1.45	4.83
TOTAL SOLIDS—						
Parts per 100,000	20.9	20.25	21.3	22.9	19.5	12.0
Grains per gallon	12.18	11.81	12.4	13.4	11.37	7.0
MINERAL MATTER—						
Parts per 100,000	18.0	17.5	18.0	20.6	18.3	9.0
Grains per gallon	10.5	10.2	10.5	12.0	10.6	5 24
ORGANIC AND VOLATILE MATTER—						
Parts per 100,000	2.9	2.75	3.3	2.3	1.2	3.0
Grains per gallon	1.69	1.60	1.92	1.34	0.7	1.75
DISSOLVED GASES BY VOLUME—						
Oxygen, cubic centimeters per liter	4.17	2.53	2.79	3.05	2.44	4.45
Carbon dioxide, cubic centimeters per liter	1.54	1.14	1.09	4.18	4.40	2.28
Nitrogen " " "	12.54	14.95	16.26	19.50	15.75	12.92
T Gases, cubic centimeters per liter	18.25	18.62	20.14	26.73	22.59	19.65

TABLE III.—HUDSON RIVER FROM WATERFORD, ABOVE TROY, TO ALBANY PUMPING STATION.

Laboratory Number	850	851	852	853	854	855	857	856
Special Number	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.
Location	Waterford, middle of river, 2 feet below surface.	Troy Pumping Station, 2 feet below surface.	River one mile below Troy (opposite Roy's Factory), 6 feet below surface.	River two miles below Troy (opposite Catholic Church), 6 feet below surface.	River three miles below Troy (above Pleasure Island) 6 feet below surface.	1,400 feet above Albany Intake (opposite Forbes' Mansion), 6 feet below surface.	1,400 feet above Albany Intake (opposite Forbes' Mansion), 6 feet below surface.	Intake of Albany Pumping Station, 6 feet below surface.
Date	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.
Color	1.0	1.25	1.25	1.0	1.0	1.0	1.0	1.0
Taste	Slightly peaty.	Slightly peaty.	Slightly peaty.	Slightly peaty.	Peaty.	Slightly peaty.	Slightly peaty.	Slightly unplnt.
Smell	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.	Slightly Unplnt	Unpleasant.	Slightly unplnt.	Slightly unplnt.	" "
FREE AMMONIA—								
Parts per 100,000	0.003	0.003	0.003	0.002	0.002	0.0025	0.0025	0.003
Grains per gallon	0.0018	0.0018	0.0018	0.0012	0.0012	0.0015	0.0015	0.0018
ALBUMINOID AMMONIA—								
Parts per 100,000	0.015	0.015	0.015	0.015	0.018	0.013	0.015	0.014
Grains per gallon	0.0087	0.0087	0.0087	0.0087	0.0105	0.0076	0.0087	0.0082
NITROUS ACID—								
Parts per 100,000	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Grains per gallon	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
NITRIC ACID—								
Parts per 100,000	0.13	0.13	0.13	0.12	0.13	0.13	0.10	0.13
Grains per gallon	0.0758	0.0758	0.0758	0.0758	0 0758	0.0758	0.058	0.0758
OXYGEN REQUIRED TO OXIDIZE ORGANIC MATTERS—[PERMANGANATE]—								
Parts per 100,000	0.47	0.477	0.41	0.445	0.445	0.477	0.47	0.477
Grains per gallon	0.274	0.278	0.24	0.259	0.259	0.278	0.274	0.278
CHLORINE—								
Parts per 100,000	0.425	0.450	0.475	0.450	0.500	0.475	0.475	0.500
Grains per gallon	0.247	0.262	0.277	0.262	0.291	0.277	0.277	0.291
HARDNESS—								
Parts per 100,000	4.71	4.57	6.43	5.86	5.7	6.0	5.7	5.86
Grains per gallon	2.74	2.66	3.75	3.41	3.32	3.5	3.32	3.40
TOTAL SOLIDS—								
Parts per 100,000	9.4	8.8	10.8	11.90	10.7	10.7	11.7	10.60
Grains per gallon	5.48	5.13	6.3	6.93	6.23	6.23	6.82	6.18
MINERAL MATTER—								
Parts per 100,000	6.1	6.2	7.5	9.20	6.9	7.5	8.5	9.40
GRAINS per gallon	3.55	3.6	4.37	5.36	4.02	4.37	4.95	5.48
ORGANIC AND VOLATILE MATTER—								
Parts per 100,000	3.3	2.6	3.3	2.70	3.8	3.2	3.2	1.20
Grains per gallon	1.92	1.51	1.92	1.57	2.2	1.9	1.9	0.70
DISSOLVED GASES BY VOLUME—								
Oxygen, cub. centimeters per liter	4 36	3.7	3.34	4.33	.....	4.62	3.93	4.50
Carbon dioxide " "	1.97	0.74	1.21	2.06	.....	1.49	1.12	0.37
Nitrogen " "	12.02	13.44	17.05	11.15	.....	11.87	11.40	14.08
Tot. Gases, cub. centim. per liter.	18.35	17.88	21.60	17.54	.....	17.98	16.45	18.95

TABLE IV.—MOHAWK RIVER, DRIVEN WELL, AND HUDSON RIVER, FILTERED AND UNFILTERED.

Laboratory Number	884.	886.	888.	889	883.	887.	885.
Special Number	XXI.	XXII.	XXIII.	XXIV.	XXV.	XXVI.	XXVII.
Location	Mohawk River, Cohoes Falls.	Driven Well, Cohoes.	Hudson River, Albany Pumping Station, unfiltered.	Hudson River, Albany Pumping Station, filtered.	Hudson River, Albany Pumping Station, unfiltered.	Hudson River, Albany Pumping Station, filtered.	Hudson River, Albany Pumping Station, unfiltered.
Date	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.	Sept. 29th.
Color	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Taste	Slightly peaty.	Slightly peaty.	Slightly peaty.	Slightly peaty.	Slightly peaty.	Slightly peaty.	Slightly peaty.
Smell	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.	Slightly unplnt.
FREE AMMONIA—							
Parts per 100,000	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Grains per gallon	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015
ALBUMINOID AMMONIA—							
Parts per 100,000	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Grains per gallon	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087
NITROUS ACID—							
Parts per 100,000	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Grains per gallon	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
NITRIC ACID—							
Parts per 100,000	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Grains per gallon	0.0758	0.0758	0.0758	0.0758	0.0758	0.0758	0.0758
OXYGEN REQUIRED TO OXIDIZE ORGANIC MATTERS—[PERMANGANATE]—							
Parts per 100,000	0.445	0.445	0.445	0.445	0.445	0.445	0.445
Grains per gallon	0.259	0.259	0.259	0.259	0.259	0.259	0.259
CHLORINE—							
Parts per 100,000	0.450	0.450	0.450	0.450	0.450	0.450	0.450
Grains per gallon	0.262	0.262	0.262	0.262	0.262	0.262	0.262
HARDNESS—							
Parts per 100,000	5.86	5.86	5.86	5.86	5.86	5.86	5.86
Grains per gallon	3.41	3.41	3.41	3.41	3.41	3.41	3.41
TOTAL SOLIDS—							
Parts per 100,000	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Grains per gallon	6.3	6.3	6.3	6.3	6.3	6.3	6.3
MINERAL MATTER—							
Parts per 100,000	7.5	7.5	7.5	7.5	7.5	7.5	7.5
GRAINS per gallon	4.37	4.37	4.37	4.37	4.37	4.37	4.37
ORGANIC AND VOLATILE MATTER—							
Parts per 100,000	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Grains per gallon	1.92	1.92	1.92	1.92	1.92	1.92	1.92
DISSOLVED GASES BY VOLUME—							
Oxygen, cub. centimeters per liter	4.33	.....	4.33	.....	4.33	.....	4.33
Carbon dioxide " "	2.06	.....	2.06	.....	2.06	.....	2.06
Nitrogen " "	11.15	.....	11.15	.....	11.15	.....	11.15
Tot. Gases, cub. centim. per liter.	17.54	.....	17.54	.....	17.54	.....	17.54

Tot. Gases, cub. centim. per liter.	18.35	17.86	21.60	17.54	.....	17.98	16.45	18.95

TABLE IV.—MOHAWK RIVER, DRIVEN WELL, AND HUDSON RIVER, FILTERED AND UNFILTERED.

Laboratory Number	884.	886.	888.	889	883.	887.	885.
Special Number	XXI.	XXII.	XXIII.	XXIV.	XXV.	XXVI.	XXVII.
Location	Mohawk Rvr., above Falls.	Mohawk Rvr. below Falls.	Hudson Rvr., Waterford.	Albany Intake.	Albany City Hall(unfiltrd.)	Albany City Hall (filtered).	Greenbush Flats, Driven Well, No. 1.
Date	Oct. 30th.	Oct. 30th.	Oct. 31st.	Oct. 31st.	Oct. 30th.	Oct. 30th.	Oct. 31st.
Color	Very turbid.	4.5	5. Very turbid	Very turbid.	2.0	0.	0.
Taste	Pleasant.	Slightly peaty	Slightly unpl.	Slightly unpl.	Pleasant.	Slightly unpl.	Pleasant.
Smell	Marshy.	None.	Vegetable.	Vegetable.	Vegetable.	None.	Slightly unpl.
FREE AMMONIA—							
Parts per 100,000	0.005	0.005	0.0065	0.0115	0.005	0.0055	0.0055
Grains per gallon	0.0029	0.0029	0.0038	0.0067	0.0029	0.0032	0.0032
ALBUMINOID AMMONIA—							
Parts per 100,000	0.018	0.016	0.02	0.021	0.0155	0 011	0.028
Grains per gallon	0.0105	0.0093	0.0117	0.0122	0.009	0 0064	0.0163
NITROUS ACID—							
Parts per 100,000	Trace.	Trace.	None.	None.	None.	0.0032	Trace.
Grains per gallon	Trace.	Trace.	None.	None.	None.	0.0019	Trace.
NITRIC ACID—							
Parts per 100,000	0.50	0.45	0.05	0.10	0.05	0.05	0.12
Grains per gallon	0.29	0.26	0.029	0.058	0.029	0.029	0.07
OXYGEN REQUIRED TO OXIDIZE ORGANIC MATTERS [PERMANGANATE]—							
Parts per 100,000	0.58	0.56	0.72	0.70	0.63	0.12	0.08
Grains per gallon	0.338	0.326	0.42	0.408	0.367	0.07	0.047
CHLORINE—							
Parts per 100,000	0.50	0.50	0.375	0.45	0.50	0 60	6.95
Grains per gallon	0.291	0.291	0.218	0.262	0.291	0.35	4.05
HARDNESS—							
Parts per 100,000	8.4	7.6	4.4	6.3	6.4	6.9	2.7
Grains per gallon	4.9	4.43	2.57	3.67	3.73	4.02	1.57
TOTAL SOLIDS—							
Parts per 100,000	16.8	12.7	7.9	13.1	1.8	9.5	32.6
Grains per gallon	9.79	7.4	4.6	7.59	6.88	5.54	19 01
MINERAL MATTER—							
Parts per 100,000	11.5	9.2	4.6	10.1	7.9	6.5	30.3
Grains per gallon	6.7	5.36	2.68	5.84	4.6	3.79	17.6
ORGANIC AND VOLATILE MATTER—							
Parts per 100,000	5.3	3.5	3.3	3.0	3.9	3.0	2.3
Grains per gallon	3.09	2.01	1.92	1.75	2.28	1.75	1.41
DISSOLVED GASES BY VOLUME—							
Oxygen dissolved in 1 liter	3.07	3.95	3.55	4.24	3.30	2.86	2.26
Carbonic Acid " "	2.82	1.72	1.48	1.60	2.90	2 97	3.54
Nitrogen " "	18.18	13.56	15.81	14.13	17.10	18.60	22.16
Total Gases dissolved in 1 liter	24.07	19.25	20.84	19.97	23.30	24.43	27.96

TABLE V.—ANALYSES OF MINERAL CONSTITUENTS.

Laboratory Number Special Number	826 I.		827 II.		828 III.		830 V.		872 XI.		½ of 884 & ½ of 886 ½ of XXI. & ½ of XXII.
Location	Snyder's Lake, Middle.		Sand Lake, Middle		Poestenkill Riv. at E. Poestenkill		Pumping Well of Alb'ny Pumping Station.		Dr. Helmes' Farm.		Mohawk River, above and below Fal's.
Date	September 4th.		September 4th.		September 4th.		September 5th.				
	Parts pr 100,000	Grs. per gal.	Parts pr 100,000	Grs. per gal.	Parts pr 100,000	Grs. per gal.	Parts pr 100,000	Grs. per gal.	Parts pr 100,000	Grs. per gal.	Parts pr 100,000	Grs. per gal.
Silicic Anhydride	0.220	0.128	0.090	0.052	0.550	0.321	0.440	0.257	0.880	0.513	1.580	0.921
Phosphoric anhydride			0.007	0.004	0.010	0.006	0.040	0.023				
Sulphuric Anhydride	0.440	0.256	0.380	0.222	0.160	0.093	0.650	0.379	0.590	0.344	1.370	0.799
Carbon Dioxide	1.570	0.916	0.440	0.257	0.090	0.052	2.648	1.545	5.310	3.097	2.030	1.184
Chlorine	0.500	0.175	0.210	0.122	0.340	0.198	0.340	0.198	2.090	1.219	0.500	0.292
Potassium Monoxide	0.040	0.023	0.070	0.041			0.080	0.047	Trace.	Trace.		
Sodium Monoxide	0.800	0.467	0.280	0.163	0.220	0.128	0.430	0.251	6.340	3.697	0.970	0.566
Magnesium Oxide	0.180	0.105	0.020	0.011	0.003	0.002	0.320	0.187	1.120	0.653	0.330	0.192
Calcium Oxide	1.440	0.840	0.620	0.362	0.300	0.175	3.060	1.784	1.530	0.892	2.610	1.522
Aluminium Oxide			0.006	0.003	0.090	0.052	0.030	0.017				
Ferric Oxide	0.100	0.058	0.064	0.037			0.310	0.181	0.490	0.286	0.730	0.426
	5.090	2.968	2.187	1.274	1.763	1.027	8.348	4.869	18.350	10.701	10.120	5.902
Deduct Oxygen for Combined Chlorine	0.210	0.122	0.080	0.047	0.050	0.029	0.120	0.070	0.470	0.273	0.110	0.064
Mineral Matters	4.880	2.846	2.107	1.227	1.713	0.998	8.228	4.799	17.880	10.428	10.010	5.838
Organic Matters	1.890	1.102	1.360	0.793	1.229	0.717	4.178	2.438	4.020	2.344	3.200	1.866
Total Solids in Solution	6.770	3.948	3.467	2.020	2.942	1.715	12.406	7.237	21.900	12.772	13.210	7.704
Silicic Anhydride	0.220	0.128	0.080	0.048	0.550	0.321	0.440	0.257	0.880	0.513	1.580	0.921
Potassium Sulphate	0.080	0.047	0.120	0.070			0.150	0.087				
" Chloride									Trace.	Trace.		
Sodium Carbonate	0.470	6.274							6.930	4.041		
" Sulphate	0.600	0.350	0.230	0.134			0.310	0.181	1.060	0.617	1.200	0.700
" Chloride	0.450	0.286	0.350	0.204	0.410	0.239	0.560	0.326	3.450	2.012	0.820	0.478
Magnesium Carbonate	0.400	0.233	0.050	0.029	0.010	0.006	0.670	0.391	2.350	1.371	0.700	0.408
Calcium Carbonate	2.570	1.499	0.860	0.503	0.200	0.117	4.970	2.898	2.720	1.587	3.780	2.204
" Sulphate			0.340	0.198	0.280	0.163	0.680	0.397			1.210	0.706
" Chloride					0.150	0.087						
Aluminium Phosphate			0.013	0.007	0.020	0.012	0.070	0.040				
" Oxide					0.080	0.047						
Ferric Oxide	0.100	0.058	0.064	0.037			0.310	0.181	0.490	0.286	0.730	0.426
Mineral Matters in Solution	4.930	2.875	2.197	1.230	1.700	0.992	8.160	4.758	17.880	10.427	10.020	5.853
Organic Matters	1.890	1.102	1.360	0.793	1.230	0.717	4.178	2.438	4.020	2.344	3.200	1.866
Total Solids	6.820	3.977	3.467	2.023	2.930	1.709	12.338	7.196	21.900	12.771	13.220	7.719
Lead, Copper, and other Injurious Metals	None.		None.		None.		None.		None.		None.	

I insert the accompanying five tables, partly to render intelligible what follows, and partly because the results are not in accordance either with the preconceived ideas of the inhabitants of Albany, or with the anticipations of the members of the Special Commission, the engineers in charge, or my own.

For, in the first place, the samples taken from the mountain lakes and streams do not compare favorably with the sample taken from the Hudson at the same date. It will be found by reference to Table I., that the albuminoid ammonia in the samples from Snyder's Lake, Sand Lake, Poestenkill River, and Dykeing Pond is greater than at the Albany pumping station, and the free ammonia is likewise greater, except in the case of Snyder's Lake. The required oxygen for the Poestenkill is enormous, as also the nitric acid of the Dykeing Pond. I conclude from the latter fact that the water in this pond contained, prior to the time of the analysis, an even larger percentage of decomposable nitrogenous matter than is indicated by its albuminoid ammonia. In other words, a large amount had been destroyed by natural processes of oxidation, and had been converted into nitric acid. The evidence of this oxidizing action is still further shown in the percentage of carbon dioxide in the Dykeing Pond sample, amounting to the very unusual volume of 6.56 c.c. per liter. The quantitative measurement of the color, which is of a yellow to reddish-yellow tint, in the two samples just alluded to, gives 1.25 and 1.75 respectively. This color is a stain due to coloring matters of peaty origin in solution, and is accompanied by a rise in the amounts of required oxygen to 1.90 and 0.60. The quantitative measurement of color in this way becomes an index of the oxidizable organic matter. The same fact is illustrated by a comparison of the waters of the Hudson taken Sept. 5th and 16th, but, in addition, these two samples expose the fallacy of an opinion popularly prevalent concerning river waters. For the first was taken immediately on resumption of pumping after an interval of four days, during which interval the river had been rendered so yellow and turbid by recent rains, that the engineers had regarded it unfit to drink. As a matter of fact, its ammonia yielding constituents had been diminished. And the same water on keeping in the laboratory [storage and sedimentation], became of a high order of purity, most of the micro-organisms either dying, or being precipitated as resting spores along with the sediment. In

the reports on the proposed new water supplies of Wilmington, Del., and Philadelphia, numerous illustrations are given of the action of suspended aluminous matter [mud], in removing the ammonia-yielding organic constituents of the water.

In this connection, the beneficial effects of recent rains in raising the percentage of the dissolved oxygen should likewise be noted. This dissolved oxygen after a time is used up in oxidizing dissolved organic impurities, the percentage of carbon dioxide at the same time rising. Furthermore, as will be seen by reference to the Dykeing Pond sample, in proportion as the organic nitrogen becomes converted into nitric acid, the oxygen essential to this process is used up, and the percentage of dissolved oxygen exhibits a correspondingly low figure.

The analyses summarized in Table III. are of interest, both as relates to the potability of sewage-polluted water, like the Hudson River at Troy and Albany, and also in relation to the question of the self-purification of a flowing stream.

It will be seen that the absolute amount of free ammonia is very small, being only 0.003 per 100,000, in four of the samples, and even less in the remaining four. The albuminoid ammonia is also moderate in amount, being less in the Waterford sample than it is in that taken at the Albany pumping station, Sept. 5th, which sample, as we have just seen, contains a smaller quantity than is present in any of the lakes of Rensselaer County. The percentage of albuminoid ammonia in the Waterford sample is the same as that present at the Troy pumping station, and also at one and at two miles below Troy. Three miles below it rises sharply in amount, an increase due unquestionably to considerable local contamination near the point where the sample was drawn from the river. But it falls again at the point 1,400 feet above the Albany intake, the sample collected on the ebb tide having less putrescible organic matters than were present in any of the eight samples taken from the Hudson at this time. At the intake itself the albuminoid ammonia is 0.014 parts per 100,000, as against 0.015 parts at Waterford, Troy, and at one and two miles below.

One mile below Troy, the amount of oxygen requisite to effect the oxidation of the organic matters is less than at Waterford, which is situated on the Hudson some distance above Troy, and entirely above and beyond the influence of the Troy sewage. And

although at certain intermediate points it again increases by organic matters locally added at these points, it does not exceed, even at the Albany intake, its amount at the Troy intake. The chlorine increases in the seven miles from Waterford to the Albany intake. This increment is a rational one, since it applies to a mineral constituent of sewage, and not to a constituent capable, like the matters above alluded to, of progressive oxidation.

All the Hudson River samples exhibit traces of nitrous acid, a very important fact, showing the reality of the existence of recent sewage contamination at every point examined. The nitric acid is the same, namely, 0.13 parts of 100,000 in all the samples taken on the ebb tide. It is notably less than the one sample taken on the flood, a result probably due to the reduction of the nitrates in contact with the fresh sewage sweeping upward past the Albany docks.

The minimum amount of dissolved oxygen is at one mile below Troy, at which point the oxygen has been exhausted by contact with the fresh sewage, and where it has had no opportunity to increase, as it does in the further run down the river.

Passing now to Table II., it will be seen that the free ammonia is much greater in the driven well than in the surface water, whilst the albuminoid ammonia is less. I attribute this result to the oxidation occurring in the pores of the ground, through which the meteoric waters filter before reaching the gravel stratum out of which they rise. In consequence of this oxidizing action, the nitrogenous matters are decomposed, and pass out of the putrescible condition in which they yield albuminoid ammonia, into the more stable form in which they yield free ammonia.

The chlorine in the wells is immensely greater than in the surface waters, but this chlorine is not indicative of infiltration of sewage, but is connected with a simultaneous large increase of all the mineral constituents due to the solution of mineral substances by the waters in the course of their filtration through the ground.

When we come to the dissolved gases, we find corresponding differences in the percentages of oxygen, due to the oxidizing action alluded to above, and inseparably connected with any process of beneficial filtration, whether it be effected by natural or by artificial means. The gases held in solution in superficial ground waters are principally derived from the atmospheric air with which these

waters are in contact, both superficially and in the interstices of the soil. Such being the case, we can readily understand why the air dissolved in the driven well samples is impoverished in respect of its oxygen, and why it contains a relatively larger amount of nitrogen. The carbon dioxide generated by oxidation processes, rarely remains permanently in solution, being used up by plant organisms for their food, or seized upon by lime and other bases to form mineral carbonates.

Table No. IV. presents in the first place a comparison of a specimen taken from the Mohawk River above the Falls, with one taken below the Falls, on the same day. They are both, like those taken from the Hudson River at Waterford and at the Albany Intake, very turbid and deeply yellow colored. That taken above the Falls, like the one from the intake, is so muddy and opaque that its color could not be qualitively estimated by means of the color-meter. In taste, both the Mohawk samples were better than those from the Hudson, that taken from above the Falls being the only one entirely agreeable in flavor.

In respect of free and albuminoid ammonia and of oxygen required to oxidize organic matters, they were superior in quality to the Hudson River samples: in respect of chlorine, hardness and total organic and volatile matters, they were inferior. I am at an entire loss to know, not having personally visited the spot and collected these samples, why the sample taken below the Falls was on the whole of better quality than that taken above. I can only infer, from the increased percentage of the dissolved oxygen gas and the simultaneous diminution of the albuminoid ammonia and of the oxygen required in the laboratory to effect the oxidation of the organic substances in the two waters, that in their passage over the Falls a notable aeration and improvement had been brought about. Simultaneously with this change, a process of subsidence and precipitation in the river below the Falls appears to have taken place, by which means the mineral matters and the hardness underwent a very considerable diminution. But, notwithstanding this improvement, I do not think the difference in quality is sufficiently in favor of the Mohawk to warrant a recommendation to transfer the source of supply to this river. This view is much strengthened by the fact that the Mohawk is a harder water than the Hudson, and the difference in this respect would result in a considerable

pecuniary loss to those engaged in manufacturing operations, and to the population at large in relation to its laundry use.

Proceeding now to the samples taken directly from the Hudson, October 21st, we note that in their physical properties the samples taken at Waterford and at Albany exhibit the same characteristics, being both dark colored, very turbid, and of slightly unpleasant taste. They show in a most striking manner an increase in the permanent mineral constituents, along with little corresponding change (and in regard to two classes of results even a diminution) in their organic constituents. For, at Waterford, the chlorine is 0.375 parts per 100,000, while at Albany it has increased to 0.45 parts; at Waterford the hardness is 4.4, at Albany 6.3; at Waterford the total solids and mineral matters are 7.9 and 4.6, respectively, as against 13.1 and 10.1 parts at the Intake of the Albany station. Referring now to the organic constituents, we see that the free ammonia at Albany is nearly double what it is at Waterford, whilst the measure of the nitrogenous impurities themselves has increased by only 0.001 part. The oxygen required to effect the oxidation of the organic matters is 0.02 parts less at Albany than at Waterford, and the total organic and volatile matters are 0.3 part less. Along with this progressive oxidation, there is an increase in the percentage of carbon dioxide originating from it.

A comparison of the water running from the faucet of the City Hall, before and after filtration, shows that an improvement has thereby been effected. The improvement is most striking in the oxygen required to oxidize the organic matters of which only 0.12 parts were required for the filtered as against 0.63 for the unfiltered. The total organic matters for the filtered is 3 parts as against 3.9 parts for the unfiltered. But, during the process of filtration, the oxygen dissolved in the water has been used up, and in its place we find an increased quantity of carbon dioxide. Not only is the filtered water very poor in oxygen, but it contains a measurable amount of nitrous acid, which is present in waters only when the average matters which they contain have undergone incomplete oxidation.

Biological Analysis.

No biological analyses were made of the Rensselaer County waters, my arrangements for this part of the work not having been

completed. The ten duplicate specimens taken from the Hudson River, between Waterford and Albany, September 29th, showed the following results: At the end of 48 hours, the culture tubes pertaining to all the specimens were unchanged. At the end of five days the gelatine in the culture tube belonging to the specimen collected opposite to Roy's factory was entirely liquefied; that in all the other culture tubes almost entirely liquefied. The number of microbes was greatest in the culture tube belonging to the specimen taken three miles below Troy, and least in the culture tubes of those specimens from the Albany and Troy intakes. Judging from the results of the biological analysis, the water collected at the Albany intake certainly did not contain more microbes than that from the Troy intake. These two waters were the best. The samples from Waterford were inferior to the two preceding, and of the three Waterford samples themselves, that from the east shore was the best, that from the middle the worst. The latter indeed was no better than the sample taken 1,400 feet above the Albany intake. In the following table I have arranged this set of Hudson River samples in two series, in one of which they are ordered in accordance with their excellence as decided upon chemical, in the other upon biological grounds:

SERIES NO. II., HUDSON RIVER SAMPLES, SEPT. 29TH.

A.—Chemical Order.	*B.—Biological Order.*
I. 1,400 ft. above Albany Pumping Station.	I. Albany Pumping Station, Troy Pumping Station.
II. Albany Pumping Station.	II. 1,400 feet above p. s., flood.
III. Waterford.	III. Two miles below Troy.
IV. Troy Pumping Station.	IV. One mile below Troy.
V. One mile below Troy.	V. Waterford.
VI. Two miles below Troy.	VI. 1,400 ft. above p. s., ebb.
VII. 1,400 ft. above Albany Pumping Station, flood.	VII. Three miles below Troy.
VIII. Three miles below Troy.	

In the biological analysis of the driven well samples, taken October 19th, and the Albany pumping station of the same date, the culture tubes of the former did not show any micro-organisms until the ninth day, when they first made their appearance, and finally brought about a liquefaction of the gelatine at various dates from the tenth to the eighteenth day. The Troy

Flat sample of this date presented similar characteristics, and underwent liquefaction in the same interval of time as the samples from the Three Hills and Dr. Helme's farm. The Albany sample exhibited organisms on the first day, began to liquefy at the expiration of sixty hours, and completely broke down on the third day with the appearance of very numerous microbes.

In the biological examination of the fourth series, the water taken from the Greenbush Flats driven well, No. 1, developed most microbes; that from the Mohawk River, below the Falls, the next largest number; that from the Albany intake followed third; that of the Albany City water, after filtering, fourth, before filtering, fifth; above the Mohawk Falls, sixth, and that from Waterford, last. Or, to rate them according to their purity, from a biological standpoint (though none of them were by any means free from microbes), their order would be as follows, the corresponding order on chemical grounds being added for comparison :

SERIES IV., FROM MOHAWK AND HUDSON, OCT. 30TH.

A.—Chemical Order.	*B.—Biological Order.*
I. Albany City Hall (filtered).	I. Waterford.
II. " " (unfiltered).	II. Mohawk River, above Falls.
III. Mohawk River, below Falls.	III. Albany water, before filtering.
IV. " " above "	IV. " " after "
V. Hudson River at Waterford.	V. Albany intake.
VI. " " Albany.	VI. Mohawk River, below Falls.
VII. Greenbush Flats, driven well.	VII. Greenbush Flats, driven well.

EXPERIMENTAL INVESTIGATION.

The analysis of the samples, before purified by oxidation processes and filtration in the manner previously indicated, will be found in the accompanying tables. My time allowed analysis of the purified samples only as far as the determination of the three most important factors free ammonia, albuminoid ammonia, and required oxygen. The results obtained were as follows :

PURIFACTION BY OXIDATION AND FILTRATION.

Snyder's Lake.

	Before Purification.	After Purification.
Free ammonia	0.002 pts. per 100,000	0.012 pt. per 100,000
Albuminoid ammonia	0.037 " "	0.012 " "

Sand Lake.

	Before Purification.	After Purification.
Free ammonia	0.009 pts. per 100,000	0.01 pt. per 100,000
Albuminoid ammonia	0.029 " "	0.01 " "

Dykeing Pond.

	Before Purification.	After Purification.
Free ammonia	0.014 pts. per 100,000	0.01 pt. per 100,000
Albuminoid ammonia	0.026 " "	0.012 pts. "
Required oxygen	0.60 " "	0.214 " "

Poestenkill River.

	Before Purification.	After Purification.
Free ammonia	0.011 pts. per 100,000	0.011 pts. per 100,000
Albuminoid ammonia	0.032 " "	0.0115 " "
Required oxygen	1.90 " "	0.88 " "

Albany Pumping Station, Sept. 5th.

	Before Purification.	After Purification.
Free ammonia	0.004 pts. per 100,000	0.01 pt. per 100,000
Albuminoid ammonia	0.019 " "	0.008 pts. "
Required oxygen	1.20 " "	0.293 " "

The meaning of these figures is, that the putrescible matter, taking the albuminoid ammonia as its index, had been mostly removed, in one instance only 30 per cent. remaining of the 100 present in the original unpurified water. And furthermore, that the total organic matter, taking the oxygen required to oxydize it as an index had been still more perfectly removed, the purified Albany intake sample containing only 24 per cent. of the oxidizable organic substances originally present.

The free ammonia, derived as it is from nitrogenous bodies by processes of oxidation, was in most instances increased.

These surprising and very gratifying results were obtained by simple means in the laboratory, and there is no practical obstacle that I know of, to their economical application on the scale necessitated by the supply of a large city like Albany.

General Comparison of Results.

On a general survey of these results, there would appear to be no good reason why the waters from any one particular locality should be exalted above all the others, and in this manner the source of supply, so far as the vital question of purity is concerned, should be settled. Only by the critical weighing of many considerations

and by the exclusion of such sources as have previously been shown to be inferior for reasons already given in the text, can the problem be so narrowed down that its solution becomes feasible.

We should, therefore, begin by excluding the samples from Rensselaer County; the Mohawk River waters; all the samples from the Hudson River proper, except those from Waterford, Troy pumping station, the Albany intake, and 1,400 feet above the intake. Then, of those which remain, we shall begin by comparing those taken from the Hudson River among themselves. In the first place, they are all alike in containing some unoxidized sewage. It is present at Waterford, at Troy pumping station, and, although undergoing a certain amount of oxidation on its way down the river, it is neither at the Albany pumping station, nor 1,400 feet above, so far eliminated that the water taken directly from the river at the Albany intake is of sufficient purity for potable use.

We shall, therefore, exclude the Hudson River as taken *directly* at any point, beginning at Waterford, down to Albany, from the recommendable sources of future supply.

The case, however, is different with regard to the Hudson waters subjected to processes of purification and filtration; for, while the particular sample of the Albany water filtered at the City Hall did not afford satisfactory results, yet it is possible by simple and practical means to purify them thoroughly, so that they shall not contain organic matters dangerous to health, nor organized particles, in the form of germs, capable of originating disease.

With regard to the driven wells, the testimony concerning those on the Troy Flats is conflicting, the earlier sample being satisfactory from a chemical and biological standpoint, whilst the latter sample was anomalous in both. Although analyses are needed in the future, to decide the cause of these anomalies, yet as far as an opinion can be formed from the nature of the evidence now in my possession, I believe them to be accidental, and that the water taken from the driven wells on the Flats, would prove to be both satisfactory for manufacturing use, and safe and wholesome for domestic purposes.

The water from the driven wells at Dr. Helmes' farm contains 10.43 grains per gal., as against 4.76 grains in the Hudson River water at Albany (see analysis of September 5th), but an examination of Table V., shows that these saline matters are not of a char-

acter to injure the water for manufacturing purposes, nor do they give other than an agreeable taste.

I would, therefore, include the water from this and the neighboring Three Hills farm, among those capable of supplying Albany with satisfactory and wholesome drinking water.

Conclusions.

Two classes of considerations must be kept in view in drawing these conclusions; the one relating to the use of a city water supply for drinking and domestic purposes, and the other, which we can by no means afford to lose sight of, in view of the enormous pecuniary interests involved, its use for laundry and manufacturing purposes.

As to the first, no water is fit for drinking and domestic purposes, unless it is entirely odorless, colorless, perfectly pellucid and transparent; free from turbidity and suspended particles; of no taste, or, if any, a pleasant one, and demonstrably free from all non-organized or organized matters (in the shape of germs) capable of originating disease.

Now, it is no proof that these requirements are either unnecessary or exaggerated, that most of the cities in this country and the old world, are supplied by water which does not conform to them. Public opinion on these matters has developed aggressive strength only during the last few years, and indeed could not be formed on impregnable grounds except with the aid of the scientific discoveries of the past ten years. Now, that it has been demonstrated that the chief agency in the transmission of cholera, typhoid fever, and zymotic diseases in general, is by means of organized germs diffused in drinking water, the popular demand for sources of water supply demonstrably free from organic impurities is imperative, and legislatures and municipal authorities must obey it.

Whenever appealed to, the courts in this country have affirmed by decisions in conformity with very emphatic charges from the bench, that corporations and individuals could not abuse the waters of a flowing stream used for water supply, by emptying sewage into it. At the present time, the citizens of Albany are drinking a residual portion of the sewage of Troy, and a part of their own sewage. The citizens of Troy are consuming as a beverage some unoxidized sewage from points above them on the Hudson. It remains for legislative enactment and a humane and wise public

opinion to compel these and all other communities to reclaim their sewage, before emptying the effluent waters therefrom into a flowing stream. Simple, economical, and completely effectual methods for so doing, are now known and practiced by sanitary engineers.

But even granting that this is done, the consumer should have the water delivered to him in the limpid and demonstrably pure condition above spoken of. And under no conditions can he be guaranteed in the possession of such a water supply, unless it be thoroughly purified and filtered immediately before use. This can be done either artificially or naturally. The water taken from the driven wells at the Three Hills and Troy Flats farms, and that taken from the Hudson River at Albany and properly purified, are equally limpid, colorless, odorless, and free from micro-organisms of every description.

From a sanitary, a chemical, an experimental and a biological standpoint, I can affirm that either of these two modes of supply will afford the people of Albany equally pure and wholesome drinking water.

With regard to their use for manufacturing purposes, a somewhat similar statement can be made.

The driven well waters contain a considerably larger amount of mineral substances in solution than the river waters. But the detailed analyses given in Table V., show that this excess is due to an increase in the amount of the soda salts, and not to an increase in the amount of lime and magnesia salts. Did they exhibit an increase of the latter constituents, they would not be, as in fact they are, soft waters, and would not be adapted for laundry use. At the same time there would be an advantage in lowering the percentage of saline constituents in the driven well water, varying as they do, from 10 to 20 grains per gallon, by using it in connection with the river water, whose mineral constituents are about 4.5 grains.

For the various reasons detailed in the body of this report, I would finally recommend :

That the City of Albany should avail itself of the advantages and guarantees of a twofold system of water supply.

I. Hudson River water, purified and filtered.

II. Driven well water.

In case the former is adopted, I would further recommend:

1st. That the water should be taken above Albany, at some point above the influence of the Albany sewage, and when time and distance had been afforded to allow the maximum possible self-purification of the Troy sewage.

2d. That the water should not be taken directly from the river, but through a curb or well, arranged to exclude the surface water and the grosser organic and mineral impurities.

3d. That the water should be brought from the intake located in this well to the present pumping station, and from thence lifted to the reservoir.

4th. That it should be purified and filtered immediately before delivery into the reservoir.

In case the driven well system is adopted, I would recommend:

1st. That as much water should be drawn from the wells in the Three Hills farm tract as they are capable of affording; and, in case they prove inadequate or it should appear desirable to extend the system,

2d. That the system should be extended to the Troy Flats.

3d. That the deficiency of oxygen in the driven well waters should be made up by charging them with air under pressure in the course of their transmission through the mains from the wells to the reservoir.

Appendix.

The above experimental inquiries are, for the reasons previously given, of a merely introductory character, but it is important to present, so far as I am acquainted with it, the history of this part of the subject. In the months of January and February, 1883, the water of the Schuylkill River became so nauseous in taste and smell that it was not potable, and I was requested by the water department of that city to examine into the origin of the malady. It was not revealed by the chemical analyses of the samples, although these analyses were extended to the determination of gaseous, mineral and organic constituents; but, by experimental treatment in the laboratory, I found that the oxygen present in solution, which was abnormally low in the original samples taken from the Schuylkill river could be readily raised to its normal amount, and that I could effect a corresponding diminution in the amount of organic constituents. It was proposed that the percentages of

organic matters which could be eliminated, and more especially the nitrogenous organic matters, should be taken as indicating the indices or co-efficients of impurity; and, similarly, the amounts of oxygen which had to be added were proposed as a measure of the inferiority of the samples examined below a feasible condition of purity.

The practical benefit of these experimental inquiries is daily experienced in the case of the water supply of Hoboken, which amounts to 4,000,000 gallons, and which for the past year and a half has had its deficiency of oxygen supplied by the injection of air under pressure, and a similar method of treatment was recommended, and is being introduced at the several pumping stations of the Philadelphia Water Department.

It is possible to obtain, by simple methods of laboratory experiment, an effectual purification of the samples submitted to analysis. This being the case, we are compelled to abandon the different standards of relative purity which have been our only reliance hitherto, and to substitute for them absolute hygienic standards. The former class of standards have frequently been deduced from the comparison of city water supplies of fair repute. It is obvious that such standards must necessarily be of a degraded character. Or, in place of general standards so established, particular standards have been proposed. For instance, the pollution of the water supplies of Newark and Jersey City is measured by the differences between the results obtained by analyses of the Passaic water at the pumping stations, and the waters of the same river before it has encountered sewage contamination. The composition of the waters at Phœnixville has been proposed as a standard of purity of the sewage polluted Schuylkill at the pumping stations of Philadelphia.

But it can be readily demonstrated by laboratory experiment that these standards themselves are usually questionable, their character breaking down on applying the severe tests of biological analysis, and a large co-efficient of removable impurities being obtained on the application of the purification processes above alluded to. Such being the case, let us set aside these questionable standards of general and particular relative purity, and replace them by what might be termed absolute hygienic standards. That is to say, let us determine what and how much of the organic con-

stituents of a water are eliminable by experimental laboratory purification. Let the fact of purification be established by biological analysis, when, if the purification is such as it should be, and such as is readily obtainable in the laboratory, biological analysis should show the destruction of micro-organisms by the purification method employed. Then let the character and analysis of the water thus purified be set up for an absolute hygienic standard in the case of the particular water experimented upon. How near, as a matter of chemical engineering, it may be desirable to realize in practice the supply to a large city of water conforming to the laboratory standard, it is foreign to the purpose of the present article to discuss. But it will be readily seen that this experimental method of water analysis supplies many facts of a practical nature, such as water commissioners demand information upon, whilst chemical analysis, *per se*, supplies such information only obscurely and inferentially. For the reasons above given, it appears to me that experimental water analysis affords the most promising field in connection with the subject of water supply.

In conclusion, I wish to state, in order to prevent my being misunderstood, that the presence of non-pathogenic microbes in sewage-polluted waters is of the greatest benefit, inasmuch as it is with the aid of the transformations effected in connection with their vital processes that oxygen is absorbed and the oxidation of decomposable organic matter principally accomplished. Furthermore, they antagonize and destroy the pathogenic bacteria, liable at all times to be associated with sewage. Their study, as a factor in water analysis, has been utilized for the reason that in proportion as sewage is oxidized with their aid, it disappears, and the diminution of sewage, the exhaustion of the dissolved oxygen, and the development of microbes, stand in definite relationship to one another. Furthermore, as the sewage is destroyed, or in waters containing no sewage, the microbes disappear for lack of favorable environment, and hence, even without determining what microbes in a water under examination are pathogenic and which are not (a problem beset at the present time with extreme difficulties), it may safely be set down that a water which is lacking both in sewage constituents and in microbes in general, and especially when it contains its normal percentage of oxygen, is hygienically pure.

ABSTRACTS.

GENERAL AND INORGANIC CHEMISTRY.

On the Alkaline Hydrates. E. J. MAUMENÉ.

An extended study of the hydrates of baryta, strontia, potash and soda.

In a previous paper on hydrates of baryta (presented to the *Acad. des Sciences*, June 11th, '83), it was shown that barium hydrate contains BaO 50%, HO 50%. The author denies in general the existence of monohydrates, whether acids or bases. Having fused the normal hydrate, containing 8.5 mols. of water, he does not obtain BaO HO but BaO $(HO)_{1.214}$. As to strontia, he concludes (Paper of January 21st, 1884, on strontium hydrate) that one hydrate is formed of one mol. of strontia and 9.583 mols. of water. He denies the existence of the hydrate SrO HO, but has found a normal hydrate SrO $(HO)_{0.821}$.

The normal hydrate of potassium oxide has been thought to be KO $(HO)_5$; Maumené establishes (Paper of October 20th, 1884), that the real hydrate is KO $(HO)_{5.22}$. This hydrate crystallizes; its solution in water is produced with absorption of heat. Another hydrate, obtained by the slow desiccation of the first, was found to be a definite hydrate KO $(HO)_{3.133}$. As for KO (HO) Maumené denies its existence. He obtained a well defined hydrate KO, $(HO)_{1.743}$; maintained for some time at a low red heat this became KO $(HO)_{1.207}$, and at a white heat KO $(HO)_{0.746}$. Similar facts are found in the case of sodium hydrate; the first hydrate crystallized is NaO $(HO)_{3.44}$ and not NaO $(HO)_5$, as has been believed. The second crystalline hydrate, prepared by igneous fusion of the first, is, according to Maumené, NaO $(HO)_{1.49}$. This hydrate, kept for $1\frac{1}{2}$ or 2 hours at a white heat, becomes NaO $(HO)_{0.498}$. In conclusion, the author says: "Hydrates of KO, NaO, BaO and SrO, have no unique formula; they never have the typical composition MO, HO. All the other hydrates follow the same rule. A hydrate L, HO (L being any body whatsoever), only exists accidentally and in very rare cases." (*Bul. Soc. chim.*, **44**, *578.*) M. L.

Three New Compounds of Rhodium. C. VINCENT.

The sesquichloride, Rh_2Cl_6 can combine with the hydrochloride

of mono-, di-, and trimethylammonium. The author describes the preparation of pure rhodium and of the chloride by the process of Sainte-Clair Deville and Debray.

The solution of rhodium chloride, concentrated and warm, mixed with the solution of the amine hydrochloride in the same condition, yields the double salt. An excess of the amine salt is necessary, the double salt being more soluble in water.

Monomethylammonium hydrochloride forms long prisms of a deep garnet red, apparently orthorhombic. They contain

Rh	21.45
Cl	51.57
$NH_2 CH_3$	25.90
	98.92

Dimethylammonium hydrochloride contanis $3H_2O$. The crystals, which are orthorhombic, have been measured by M. Friedel. The desiccated salt contains

	Found.	Theory.
Rh	22.82%	22.85%
Cl	46.40%	46.81%

The salt of trimethylammonium is very soluble; a slow evaporation gives rise to long prisms of a garnet color. Composition.

		Theory.
Rh	20.48%	20.90%
Cl	42.35%	42.86%

These three salts are decomposed by heat; the chlorine cannot be determined directly in the salt on account of the formation of a chlororhodiate of silver of a pink color. The salt must be previously fused with sodium carbonate in a platinum dish; sodium chloride is formed; the mass, after fusion, is treated with water and filtered to separate NaCl from rhodium oxide. (*Bul. Soc. chim.*, **44**, *11.*)

M. L.

On Aluminium Oxychlorides. P. Hautefeuille and A. Perrey.

The authors did not succeed in producing the direct combination of alumina and aluminium chloride, but obtained the oxychloride by passing a mixture of oxygen and vapors of aluminium chloride

over metallic aluminium heated in a tube. The metal becomes incandescent, and yields a crystalline, very brittle substance. The proportions of Cl and O vary with the temperature of the reaction, oxygen being more abundant when the temperature has been higher. The body is not a mixture of Al_2O_3 and Al_2Cl_6, as the product of reaction is entirely soluble in very dilute acids and alkalies. Similar bodies are produced by passing Cl and O over aluminium. (*Comptes rend.*, **100**, *1219.*) M. L.

On Alloys of Cobalt and Copper. G. GUILLEMIN.

Those alloys are obtained by direct fusion under borax and charcoal. They contained from 1 to 6% of cobalt. They can be forged, wire-drawn and rolled like copper, but are more tenacious. Wires break under tension of from 25 to 36 kilos. per sq. mm. (*Comptes rend.*, **101**, *433.*) M. L.

Crystallized Zinc Hydrate. J. VILLE.

Prismatic zinc hydrate is easily prepared by treating neutral or basic zinc carbonate with a solution of potash of $\frac{1}{10}$ strength. The quantity of potash must be exactly double the amount necessary to displace the zinc. The easiest way to prepare zinc carbonate is to pass CO_2 into ZnO in the presence of water.

The prisms are more or less modified, and are flattened and truncated according to the concentration of the liquid and quantities of material. (*Comptes rend.*, **101**, *375.*) M. L.

Preparation of Arsenic Acid. A. JOLLY.

The directions given by Kopp to use dilute nitric acid (1.35) for the oxidation of arsenious acid are said by the author to be justified by the fact that both arsenical acids can combine in the proportions of 3 to 2, 2 to 1, and 1 to 1, but these combinations are destroyed by water. The combinations are well crystallized, but cannot exist in presence of dilute nitric acid. (*Comptes rend.*, **100**. *1219.*) M. L.

On the Oxide of Thorium. L. TROOST.

The author, in order to determine whether the oxide is ThO_2 or ThO, tried to ascertain if it formed, like silica, a compound $XO_2P_2O_5$ (Hautefeuille and Margottet). By treating metaphosphoric acid with anhydrous thorium chloride, he obtained ortho-

rhombic crystals, whereas silicum phosphate crystallizes in octahedra. Those crystals have the formula

$$ThO\ P_2O_5, \text{ or } ThO_2\ 2PO_5.$$

On the other hand the vapor density, taken in Meyer's apparatus (atmosphere of nitrogen, bath of boiling zinc), was found to be 5.90, 7.01 and 7.49. These numbers are very near of 6.48, which corresponds to the oxide ThO, or (Th=58.1; O=8). *Comptes rend.*, **101**, *360.*) M. L.

Some Reactions of CO_2, CS_2 and CO_2. A. Eiloart.

A mixture of CO_2 and vapor of CS_2 passed over copper at a high red heat, yields CO. When copper is omitted there is no decomposition of CO_2. The action is ascribed to nascent carbon resulting from decomposition of CS_2 in the formation of Cu_2S ($CS_2+CO_2+2\ Cu_2=2\ CO+2\ Cu_2S$); a reaction which may be regarded as taking place in two stages, one of which involves the separation of C, the other its oxidation by CO_2. If SO_2 be substituted for CS_2, CO_2 is formed, amounting, under given conditions, to half of the volume of the issuing gas, less about 5% of CO resulting from a secondary reaction. CS_2 and SO_2 react below a red heat, even without the intervention of copper, to form CO_2. Experiments with carbon carefully purified and heated in a current of SO_2 showed also an oxidation of C at the expense of SO_2. (*Chem. News*, **52**, *184.*) A. A. B.

Absorbents for CS_2 Vapor. A. Eilbort.

In order to separate these vapors from mixtures of CO_2 and CO in gas analysis, the author tried various absorbents by passing a mixture of air and vapor of CS_2 through them. The substances tried were caoutchin, roll sulphur (powdered), iodine (followed by solid paraffin to stop the iodine vapor), potassium trüodide (with paraffin guard), solution of Br in K Br, and linseed oil. Iodine is the best absorbent but inconvenient in extended use. Linseed oil introduced with the mixture of gases into a Crum's tube, was found to answer every purpose. (*Chem. News*, **52**, *184.*)

A. A. B.

On the Source of the Hydrogen Occluded by Zinc. G. Williams.

The author has already suggested that the hydrogen in zinc dust

and in meteorites may have a common oxygen, *i. e.*, exposure to a moist atmosphere. Experiment now shows, in respect to zinc dust, that the yield of hydrogen is much increased by wetting and subsequent drying of the dust. A sample of dust so treated yielded, on heating, almost twice the volume of hydrogen contained in the original dust. It is also found that zinc dust absorbs water readily from a moist atmosphere and that the volume of hydrogen obtained from zinc so treated was about seven times that from an equal weight of the original dust. (*Chem. News*, **52**, *205*.) A. A. B.

Oxydation of Iodine in the Process of Nitrification. A. MUNTZ.

To explain the presence of iodic acid in the sodium nitrate, the author tried to ascertain whether the organism which produces nitrification could not at the same time oxidize iodine. Potassium iodide put in the centre of a body undergoing nitrification gave rise to iodic acid. (*Comptes rend.*, **100**, *1136*.) M. L.

ORGANIC CHEMISTRY.

Picrylsulphonic Acid and Sodium Picrylsulphonate. C. WILLGERODT.

Fuming nitric acid gives with picryldisulphide only picric acid and sulphuric acid. Sodium picrylsulphonate is easily formed by heating an acoholic picrylchloride solution, with an excess of sodium acid sulphate. It crystallizes with two mol. water in colorless rhombic or rhombohedral crystals. By the addition of an alkali it is decomposed into picrate and sulphite. Picrylsulphonic acid is obtained by adding sulphuric acid to the sodium salt. It crystallizes with two mol. water. Its melting point is 185°. It is easily soluble in water, alcohol and ether, soluble with difficulty in chloroform, insoluble in benzol. (*Jour. prakt. Chem.*, **32**, *117.*) F. P. V.

Studies on Fatty Bodies. CH. DUBOIS and L. PADÉ.

A continuation of previous papers, it contains tables showing the solubility of fatty bodies in absolute alcohol, acetone, acetic ether and amylic alcohol; the temperature of solidification, and the solubility of the fatty acids in mixtures of animal fats with butter, and acids. The conclusions are that a knowledge of the solubility of the fatty acids is indispensable in the analysis of a butter, and that this knowledge is often sufficient to decide the presence of a foreign fatty body. (*Bul. Soc. chim.*, **44**, *602.*) M. L.

On Pathological Urine. A. VILLIERS.

The results of Bouchard and Pouchet, who have announced the discovery of alkaloids in normal urine, are questioned by the author. Examinations of many samples of urine taken from nine subjects in good health, gave negative results in seven cases. In the urine of persons suffering from different diseases, e. g., roseola, diptheria, pneumonia, phthisis and abscess of the head, but to whom no alkaloid had been administered medicinally, alkaloids were found. Bouchard has found them in the urine of typhoid patients. The author has also found alkaloids in his own urine during slight indisposition, but none when in health. He concludes that while normal urine is free from these bodies, slight derangements of the system may lead to their formation. (*Arch. de Pharm.*, **1**, *12.*)

A. A. B.

Composition of Edible Swallow's Nests. J. R. GREEN.

The mucilaginous matter composing this well known Chinese delicacy is, according to Everard Howe, the saliva of the bird itself and is a nitrogenous substance, intermediate between albumin and gelatine. The author has studied this substance anew. It is found to swell up in water, but not to dissolve, either cold or hot, but dissolves readily in lime water or baryta water, yielding a solution which becomes opalescent on addition of acetic acid, but is not precipitated. It gives an abundant red precipitate with alcohol, and shows the xanthoproteic reaction, but is not affected by Millon's reagent. These reactions indicate a glandular product, but it is not known whether the substance is a salivary or a peptogenic secretion. It possesses no power of fermentation, does not transform starch nor act upon fibrine. It resists the action of pepsine, but is attacked by the pancreatic juice. The author believes it to be analogous to the mucine of Eichwald, but finds it difficult to fix its place among the albuminoids. (*Arch. de Pharm.*, **1**, *14.*)

A. A. B.

Heat of Combustion of Certain Amines. A. MULLER.

The author tells how the purity of each body was determined. The combustion was effected in Berthelot's calorimeter. The following results were obtained:

	Heat of combustion of one molecule.		Heat of combustion of 1 grm.	Heat of formation of the molecule.
	Gas.	Liquid.	Gas.	Gas.
	Cal.	Cal.	Cal.	Cal.
Monomethylamine	256.9	----	8.276	9.6
Dimethylamine	426	----	9.458	3.5
Trimethylamine	577.6	----	9.783	14.9
Diethylamine	724.4	716.9	9.918	31.1
Triethylamine	1047.1	1038.3	10.363	34.4
Monoisoamylamine	876.4	867.6	10.069	42.1

The number 577.6 found for trimethylamine is quite different from 592, that found by Berthelot. The preparation of the amine is described. With the above figures the heat of substitution of the radicals for the H of NH_3, is calculated, using J. Thomsen's formula. (*Bul. Soc. chim.*, **44**, *609.*)

M. L.

On the Chemical Composition of the Milk of the Porpoise. PURDIE.

A small quantity of milk was obtained from the *mamma* of a porpoise recently caught in the Bay of St. Andrews. The milk was a thick, yellow liquid of fishy smell and of sp. gr. differing little from that of water. An analysis, which was somewhat imperfect, because of the small quantity of material, showed the following composition:

Water,	41.11	Fat,	45.80
Albuminoids,	11.19	Milk Sugar (?)	1.33
Ash,	0.57		

(*Chem. News*, **52**, *170.*) A. A. B.

ANALYTICAL CHEMISTRY.

Behavior of Nitrates in Kjeldahl's Process. R. WARRINGTON.

The application of this well known process for determination of nitrogen in organic bodies fails in respect to nitrogen of nitrates. Kjeldahl has shown that a portion of this nitric nitrogen is converted into ammonia in his process, under the influence of organic matter. The removal of nitrates by heating with oil of vitriol and ammonium sulphate, a method used in other cases, is inapplicable here for the above reason, although the author shows that the loss of ammonia (probably occurring through formation and subsequent decomposition of ammonium nitrate), can be practically prevented by addition of a small quantity of water. Apparently the most available method is one in which the nitrates are decomposed before adding concentrated sulphuric acid to the organic substance. Such a method the author finds in treatment of the organic substance. containing nitrates, with an excess of ferrous sulphate and strong HCl. Nitric nitrogen being thus removed, the mass is dried and the process of Kjeldahl is applied as usual. The results are fair. Further experiments are promised. (*Chem. News*, **52**, *162.*)

A. A. B.

Note on Warrington's Modification of Kjeldahl's Process. H. B. YARDLEY.

The loss of N on addition of water to the mixture of conc. H_2SO_4 and organic matter, regarded by Warrington as due to action of nitrous acids on ammonia or amides, may be so explained when nitrates were originally present, but in their absence there is still a loss of nitrogen, which the author ascribes to decomposition of nitrogenous matter by SO_2 resulting from the reaction of H_2SO_4 on organic matter.

Mixtures of wool dust and chamber acid (H_2SO_4 90° Tw.) were heated to disintegration of the dust, after passage of CO_2 to remove air, and CO_2 was again passed to remove gases set free by the action of H_2SO_4. After absorption of CO_2 by potash, a residue of nitrogen was found. In a similar experiment in which the mixture was distilled, the distillate had the odor and taste of SO_2, and on neutralization and evaporation yielded N by combustion with soda-lime. (*Chem. News*, **52**, *220.*) A. A. B.

A Modification of Kjeldahl's Method. H. HILFAHRT.

The author adds a metallic oxide or salt to the sulphuric acid serving for the destruction of organic matter, with the effect of hastening the process. Cupric sulphate is preferred. The effect is said to be a saving of seven-eighths of the time otherwise necessary. (*Chem. News*, **52**, *221, from Mon. Sci.*) A. A. B.

Digestion Furnace for Kjeldahl Nitrogen Determinations. N. KREUSLER.

This gas furnace is constructed with burners, in pairs, opposite one another, with simple chimney and screw-valves. The digestion is carried on in glass flasks reclining on wire gauze over the burners. (*Zeit. anal. Chem.*, **24**, *393.*) F. P. V.

Uranium Acetate as a Reagent for Albuminoids. N KOWALEWOKY.

Under certain conditions, uranium acetate gives a precipitate with albuminous bodies. This precipitate is somewhat soluble in water. It retains the characteristics of albumen, but uranium is only detected after acidifying. For washing the precipitate it is

well to use alcohol. The precipitate is soluble in acids. In alkalies it is soluble with decomposition. A precipitate is gotten when only .019% albumen is present. In albuminous urine the test may be carried out by redissolving the precipitate of phosphate and albuminoid, and then adding concentrated nitric acid which causes the reseparation of the albumen. (*Zeit. anal. Chem.*, **24**, *551.*)

F. P. V.

Critical and Experimental Review of the Knop-Hufner Method for the Determination of Urea. CARL JACOBJ.

The modifications of the method are noted, but the original directions of Knop are followed in the experiments, making use of the empirical correction advised by Hüfner. The method is tested with solutions of pure urea, normal and pathological urine, and urine to which glucose or aceto-acetic ether have been intentionally added. Comparative determinations are also made with the Liebig-Pflüger method. Certain adverse criticisms on the Knop-Hüfner method are discussed, and the author concludes that it is better suited for accurate scientific researches than the Liebig-Pflüger method. (*Zeit. anal. Chem.*, **24**, *307.*)

F. P. V.

On the Detection and Determination of the Bases of the Pyridine and Quinoline Series. O. DE CONINCK.

The author has studied quinoline resulting from the decompositions of brucine by caustic potash. The fraction passing from 150° to 170°, contains chiefly β-lutidine, and a small quantity of an isomeric lutidine.

He submitted the chloroplatinates to Anderson's reaction (boiling water). The β-lutidine is entirely transformed, while the other base is nearly all transformed into the double salt.

$$[(C_7H_9NCl)_2, PtCl_2 + C_7H_9(NCl)_2\ PtCl_4.]$$

	Found.	Theory.
Pt	33.20%	33.41%
Cl	29.80%	30.11%

This salt, treated again with boiling water, gave the modified salt.

$$(C_7H_9NCl)_2 + PtCl_2.$$

These reactions establish, beyond a doubt, the existence of another pyridine base besides β-lutidine.

Determinations of this base, by the means of the platinochloride and of the aurochloride, were made.

As for the double salts of the pyridine dihydrides, the modification of the platinochloride ($PtCl_2$ compound), must be made with tepid water. The gold salts cannot be handled on account of their tendency to decompose. The author uses this ready reduction of the gold double salts to characterize the quinoline and pyridine hydrides in the presence of the pyridine and quinoline bases. (*Bul. Soc. chim.*, **44**, *617.*) M. L.

Rapid Determination of Nitric Acid. A. GRANDVAL and H. LAJOUS.

This process depends upon the transformation of phenol into picric acid by the nitric acid present, and the comparison of the color of the ammonium picrate formed with a standard solution of this last salt.

The nitric solution is neutralized and evaporated to dryness, the residue is treated with sulphophenic acid (30 gms. pure phenol, 37 gms. pure SO_3). Water and excess of ammonia are then added. The operation is repeated with a standard solution of potassium nitrate ; then the solutions are compared by means of Duboscq's colorimeter. This process is rapid and delicate; nitric acid determinations in air can be made in quick succession by passing a known volume of air through a solution of sodium carbonate, passing 50 liters for each determination. (*Comptes rend.*, **101**, *62.*) M. L.

The Combustion of Carbohydrates by Means of Chromic Acid. C. F. CROSS and E. J. BEVAN.

In the course of their researches upon cellulose, the authors have tried processes involving the above principle. An apparatus like that of Fresenius & Will for estimation of CO_2 was first tried but later a modification of the Schiebler apparatus was found more suitable. The substance, mixed with or dissolved in strong H_2SO_4, is contained in a small flask in which is placed also a short tube containing chromic acid, which can be mixed with the substance as desired, by including the flask. The conversion of C into CO_2 is not complete, but inasmuch as the two oxides of carbon CO and CO_2 have the same volume, the volume of gas evolved is a representa-

tive of the carbon contained in the substance. Combustions of Swedish filter paper by this method yielded C 43.65%—43.80%. Theory for cellulose 44.4%. The applicability of this method to other organic substances is to be further tested. (*Chem. News*, **52**, *207.*) A. A. B.

Detection and Determination of the Sulpho- Compounds of Fuchsine in Wines. P. Cazeneuve.

The author describes the process of Ch. Girard (potash and mercuric acetate), and the process of M. Bellier (magnesia and mercuric acetate). In the last the wine (10 c.c.) is mixed with the powder and boiled. The solution is filtered, and passes colorless. The addition of an acid gives a red coloration in case of the presence of a sulpho- compound of fuchsine.

50 c.c. of the wine are shaken with 50 grams of manganic oxide for 5 minutes. Only the wines colored with the sulpho-compounds of fuchsine remain red ; all the others are discolored, even those containing fuchsine, and especially the azo- compounds. (*Bul. Soc chim.*, **44**, *611.*) M. L.

A Modification of the Molybdate Method of Estimating Phosphorus in Steel. E. F. Wood.

The exact determination of phosphorus in steel by precipitation from the nitric acid solution, without evaporation to dryness is impossible. The author finds the loss of phosphorus to be about one-third. He avoids the error by dissolving steel in nitric acid containing chromic acid.

The yellow precipitate obtained by molybdate is dried at 100°, and weighed directly. If 1.63 grm. of steel be taken for analysis, each mg. of precipitate corresponds to .001% P. Full details of the process are given. The process is said to be rapid and accurate. It is not applicable to cast iron. (*Chem. News*, **52**, *279.*) A. A. B.

Analysis of Staurotide. M. Coloriano.

This mineral is a silicate of iron and alumina ; the author analyzed staurotide from the St. Gothard, and removed the foreign minerals by digestion in diluted hydrofluoric acid. The sample was finely pulverized, and treated under pressure at 210° with 9 c.c. of H_2SO_4 and 6 c.c. water for 1 grm. of mineral. The ferrous oxide is determined with permanganate. In one analysis he found :

FeO	9.13
Fe_2O_3	6.83
Al_2O_3	54.20
SiO_2	27.38
Water	1.43
	98.97

The author proposes for staurotide the formula,

$$5SiO_2, 6Al_2O_3, 2FeO, H_2O,$$

and he supposes that at the time of its formation staurotide was a silicate of alumina and of ferrous oxide, which was afterwards partly oxydized in the air. (*Bul. Soc. chim.*, **43**, *427.*) M. L.

The Detection and Determination of Fluorine. G. TAMMANN.

This is a discussion of the methods in use, with experiments as to their usefulness. The author recommends in the case of soluble fluorine compounds the decomposition with silicic and hydrochloric acids, with the addition of potassium acetate and alcohol, filtering, washing with alcohol and titrating with potassium hydroxide (or gravimetrically substituting hydriodic acid for hydrochloric), then adding barium acetate and alcohol, filtering, treating the filtrate with alcohol containing hydrofluoric acid, and then weighing the barium silicofluoride, or converting it into barium sulphate. For difficultly soluble fluorides, first decompose with sulphuric acid in the apparatus in general use, determining the fluorine in the water of the absorption apparatus as above. The loss of fluorine during the incineration of organic substances is not prevented by an excess of barium hydroxide and sodium carbonate. (*Zeit. anal. Chem.*, **24**, *328.*)

Determination of Potassium Acid Tartrate in Argol, etc. F. KLEIN.

The method adopted by the author depends upon the insolubility of the acid tartrate in a solution of potassium chloride. The systems of analysis in general use are also discussed. (*Zeit. anal. Chem.*, **24**, *379.*) F. P. V.

Moisture Retained by Gases Dried by Means of Sulphuric Acid. E. W. MORLEY.

The author finds that the five-hundredth part of a millogram is retained per liter of air. This corresponds with the amount noticed

by Dibbits as removable by phosphorus pentoxide from air dried by sulphuric acid. Experiments showed that one liter of air in passing through sulphuric acid (1.84 Sp. Gr.), took up one two-thousandth to one three-thousandth millogram of sulphur trioxide. For full description of the apparatus and method used, reference must be made to the original article. (*Zeit. anal. Chem.*, **24**, *533.*)

F. P. V.

A New Method for Determining Alumina. K. J. BAYER.

The method depends upon a precipitation and re-solution of the alumina with normal sodium hydroxide solution, adding then litmus and titrating with normal sulphuric acid to reddening. Another portion is precipitated and dissolved in the same way. Tropaeolin is added and the titration, with normal sulphuric acid, is carried out to the orange color of tropaeolin. The difference between the amounts of sulphuric acid used corresponds to the alumina present. (*Zeit. anal. Chem.*, **24**, *542.*) F. P. V.

Use of Sodium Bromate in Volumetric Analysis. KRATSCHMER.

This salt, which is easily gotten by the addition of bromine in excess to hot sodium hydroxide solution, and may be purified by recrystallization, is shown by the author's experiments to be a convenient and satisfactory means for the titration of iodine solutions in volumetric analysis. It sets free from such solutions, when acidified with mineral acids, the exact amount of iodine corresponding to the oxygen it contains. (*Zeit. anal. Chem.*, **24**, *546.*)

F. P. V.

Separation of Zinc and Cadmium by Electrolysis. S. ELIASBERG.

The author having examined the conditions favorable to the success of Iver's electrolytic process for the separation of these metals, finds the most favorable conditions to exist when the metals are brought into the form of double oxalates, by adding potassium and ammonium oxalates. The amount of liquid should not exceed 90 c. c. ; and the liquid must be kept warm while a current of .01–.015 ampère is passed through for 6–7 hours. This is the time necessary for .15 grams of the metal. The cadmium separates uniformly and smoothly, and sometimes crystalline. (*Zeit. anal. Chem.*, **24**, *548.*) F. P. V.

Abstracts of American Patents Relating to Chemistry.

(*From the Official Gazette of the U. S. Patent Office.*)

November 17th, 1885.

330,381.—Process of drying air for metallurgical operations. J. H. Cremer.

330,415.—Open hearth furnace for iron and steel. O. Murisier and P. C. Gilchrist.

The furnace is lined with calcined lime mixed with tar.

330,454.—Process of precipitating nickel and cobalt from solutions containing the same. C. H. Aaron.

The metals are precipitated as methylsulphocarbonates.

330,602.—Manufacture of cement. H. Mathey.

Cement rock is ground to fine powder and then calcined.

330,602.—Manufacture of lime. H. Mathey.

Limestone is crushed or pulverized and burnt in a revolving cylinder.

330,613.—Manufacture of rosin compounds. D. J. Ogilvy.

To form a vehicle for paints, printing inks, etc., rosin is saponified with an alkali, and then dissolved, preferably in a mineral oil.

330,637.—Process of purifying petroleum. J. H. Tiemann.

Powdered silicious or other inorganic substance is agitated with the mixture of acid and oil.

330,731.—Process of manufacturing coke. H. M. Pierce.

330,732.—Furnace for the manufacture of coke. H. M. Pierce.

330,747.—Process of producing illuminating gas. R. H. Smith.

Natural gas is heated to a sufficient temperature to decompose and convert a fluid hydrocarbon into a fixed gas, and such hydrocarbon is then brought in contact with the heated natural gas.

330,778.—Apparatus for making gas. W. P. Elliott.

Brief.—Coal is distilled in closed retorts and the resulting gas is passed separately to the main. Water-gas is generated in the fuel chamber or furnace below the retort chamber, is carbureted with oil vapor in the retort chamber and the mixed gas and vapor is converted into a fixed gas in the fixing chamber. The retorts are heated by products of combustion from the fuel and by the hot water-gas circulated around them.

330,815.—Manufacture of lactates. C. E. Avery.

November 24th, 1885.

330,884.—Apparatus for freezing liquids. E. Fixary.

330,894.—Safety paper for checks, drafts, etc. F. M. Hill.

Manganese ferrocyanide and hydrated ferric oxide are added to the paper pulp or sizing.

331,059.—Manufacture of β-naphthol-sulphonic acid. M. Hoffmann.

β-naphthol-γ-sulpho- acid is produced by first sulphonating β-naphthol α-monosulpho- acid or β-naphthol, and purifying the acid.

331,104.—Process of covering metallic objects with an electroplating of magnetic oxide. W. H. Winslow.

Brief.—Electroplates with iron, and then converts iron into magnetic oxide, by means of superheated steam.

331,105.—Magnetic-oxide-of-iron-plated ware. W. H. Winslow.

331,190.—Disinfecting and cleansing liquid for animals, etc. H. Endemann.

Consists of heavy oil of coal tar, spirits of wood tar, potash soap, and potash solution.

331,225.—Process of treating heating and illuminating gases. W. F. Browne.

331,243.—Manufacture of cement. W. Joy.

331,249.—Process of making zinc sulphide pigment. T. McFarlane.

December 1st, 1885.

331,312.—Composition for fireproofing and other preservative purposes. A. J. Martin.

A composition of glycerine, ammonium carbonate, ammonium chloride, potassium tartrate, potassium oxalate, and boric acid.

331,323.—Manufacture of pulp from woody matter. R. P. Pictet and G. L. Brélaz.

Wood is subjected to the action of a saturated solution of sulphurous acid, at a temperature not exceeding 100° C.

331,383.—Mixed paint. H. C. Dorr.

A ship paint consisting of oil of tar, gum shellac, calomel, and gypsum.

331,457.—Mode of and apparatus for making ice, refrigerating, etc. A. G. Southby.

331,541.—Baking powder. A. Peters.

Consists of calcium, magnesium, or strontium carbonate, and an acid sodium sulphate, or other equivalent acid sulphate of an alkali.

331,542.—Baking powder. A. Peters.

Consists of an acid calcium phosphate, and calcium, magnesium or strontium carbonate.

331,621.—Apparatus for making illuminating gas. F. Egner.

331,632.—Polishing composition. H. L. Haas.

A compound of tar and fatty substances and polishing materials.

331,702.—Method of treating cotton seed and analogous oils. J. B. Grant and A. Mason.

The oil is partially distilled in the presence of carbon dioxide, and then saturated with the gas.

December 8th, 1885.

331,775.—Food compound. A. A. De Puy.

Consists of sugar, potassium nitrate, glycerine, sodium bicarbonate, sodium protoxide, sodium chloride, water, and milk.

331,777.—Dyeing aniline black. A. N. Dubois.

The fabric is first soaked in a bath of soluble castor oil, then for about three hours in a bath consisting of water, aniline oil, hydrochloric acid, ferric nitrate, and potassium bichromate, after which it is finished in a bath of soap.

331,810.—Cleaning fluid. C. T. Mutchler.

Consists of alcohol, sulphuric ether, salts of tartar, potassium cyanide, and ammonium hydrate.

331,860.—Apparatus for extracting mercury from its ores. H. Berrens.

331,903.—Process of manufacturing illuminating gas. J. W. Mitchell.

The process consists in, first, bringing a body of fuel to incandescence; second, passing air and superheated steam simultaneously through the fuel; third, injecting superheated steam and crude petroleum into a chamber with which the water-gas generating chamber is connected; and, fourth, purifying the gas.

331,942.—Tanning hides and skins. T. R. Clark.

The hides are repeatedly treated with a compound of potassium carbonate, water, and animal oil.

331,964.—Manufacture of benzylated methyl violet. H. Hassencamp.

331,965.—Manufacture of benzylated acid violet. H. Hassencamp.

Methyl violet is reduced to its leuco- base, which is benzylated, and converted into its leucosulpho- acid, from which the sulpho- acid of the dye stuff is obtained by oxidation.

332,087.—Apparatus for manufacturing non-luminous heating gas. J. Kidd.

December 15th, 1885.

332,320.—Apparatus for distilling wood. T. H. Berry.

332,358.—Producing chloriodine double combinations from pyridine and chinoline bases. E. Ostermayer and M. Dittmar.

Pyridine, chinoline, tetrahydrochinoline or chinoline methylate are treated with chloriodhydrochloric acid.

332,364.—Process of producing photographs in permanent pigments. W. W. Sherman.

332,441.—Process of making crystalline glass. E. A. Savary.

The glass is coated with a solution of Epsom salt, which is allowed to dry, and the coated surface is treated with hydrofluoric acid.

332,458.—Process of manufacturing fluxes. H. F. Taylor and G. Leyshon.

332,497.—Artificial fuel and process of making the same. W. H. Cory.

Carbonaceous matter and potassium or sodium silicate are mixed together, and the mixture is subjected to the action of an acid to set free the alkali. The resulting mass is compressed into cakes.

332,498.—Carbonaceous fuel and process of making the same. W. H. Cory.
Consists of carbonaceous dust, potassium silicate, and alumina.

332,528.—Dye stuff made from diazonaphthaline. M. Hoffmann.

332,569.—Apparatus for manufacturing illuminating gas. J. L. Stewart.
Brief.—Heating and illuminating gases are made in the same apparatus by combustion of fuel in the decomposing chamber and of the resulting gaseous products in a steam superheating chamber, then superheating steam by passage down through such superheater, decomposing it by passage down through the incandescent fuel and conducting the resulting gases off at the base of the fuel chamber. When the apparatus is reduced to the proper temperature, oil spray is injected into the top of the superheating chamber by means of a jet of waterrgas under pressure, and the resulting oil vapor is converted into hydrocarbon gas by passage through such chamber.

December 22d, 1885.

332,705.—Apparatus for chloridizing gold, silver and other ores. H. H. Eames.

332,736.—Metallic alloy or compound in producing the same. H. J. F. Niewerth.
The process of alloying heavy metals with metallic sulphides, which consists in first dissolving the sulphide of the metal in molten zinc, then mixing the product with the heavy metals, and finally removing the zinc by cuppellation.

332,751.—Production of cold. A. J. Rossi.
Uses carbon dioxide with sulphuric ether.

332,751.—Production of cold. A. J. Rossi.
Uses a ternary liquid consisting of carbon dioxide combined with a binary volatile absorbent.

332,756.—Stove polish. W. T. See.
Consists of water, dextrin, plumbago and lamp black.

332,829.—Manufacture of β-naphthylaminesulpho- acid. H. Prinz.
The β-naphtholsulpho-acid described by Schaefer is treated with ammonia at a temperature of about 180°–200° C.

332,830.—Red coloring matter from β-naphthylaminesulpho- acid. H. Prinz.
Obtained by combining β-naphtholdisulpho- acid with the diazo-compounds of β-naphthylaminesulpho- acid.

332,868.—Composition of matter for waterproofing paper. C. S. Bird.
Consists of resin, paraffin and sodium silicate.

332,957.—Process of manufacturing illuminating gas. B. Sloper.
Gas is generated by simultaneously acting upon metal scrap and marble dust with dilute acid. The resulting gas is enriched with hydrocarbon vapor.

333,034.—Manufacture of color producing acids. H. Vollbrecht and C. Mensching.
A new naphtholdisulpho- acid, derived from naphthylaminesulpho- acid.

333,035.—Coloring matter derived from α-naphtholdisulphonic acid. H. Vollbrecht and C. Mensching.

The diazoxylol compound of α-naphtholdisulpho- acid.

333,036.—Nitronaphtholsulphonic acid. H. Vollbrecht and C. Mensching.

333,037.—Manufacture of dyestuff from naphthol. H. Vollbrecht and C. Mensching.

Produced by the reaction of diazoazobenzol with the solution of the sodium salt of naphtholdisulpho- acid.

330,038.—Manufacture of dyestuff from naphthol. H. Vollbrecht and C. Menschinger.

Produced by the reaction of diazotoluol with the solution of the sodium salt of naphtholdisulpho- acid.

333,039.—Coloring matter derived from diazobenzol and α-naphtholdisulphonic acid. H. Vollbrecht and C. Mensching.

333,040.—α-naphtholsulphonic acid. H. Vollbrecht and C. Mensching.

333,041.—Coloring matter derived from diazobenzol and α-naphthol. H. Vollbrecht and C. Mensching.

Produced by the reaction of diazobenzol with the sodium salt of naphtholmonosulpho- acid.

333,042.—Coloring matter derived from α-naphthol and diazotolnol. H. Vollbrecht and C. Mensching.

Produced by the reaction of diazotolnolsulpho- acid with the sodium salt of naphtholmonosulpho- acid.

W. R.

ERRATA.

p. 44, table at bottom should read as follows:

Percentage of water, as determined	3.00
" glucose, guessed at	.30
" ashes, multiplied by $6\frac{2}{3}$ (2.50×6.8)	17.00
	20.30

p. 61, 13th line from bottom, for "nitrate" read "nitrite."

p. 106, 13th and 16th lines from bottom, for "V" read "U."

p. 136, middle of page, for "3.75%" read "13.75%."

p. 137, bottom of page, for "86%" read "96%."

p. 194, top, for "Kellar" read "Keller."

p. 206, 13th line from bottom, for "Thekulé" read "Kekulé."

p. 246, middle of page, after "Bromamidophenols" read "F. Schütt."

LIST OF OFFICERS,

PAST PRESIDENTS,

HONORARY MEMBERS, MEMBERS AND ASSOCIATES

OF THE

American Chemical Society.

DECEMBER, 1885.

OFFICERS
OF THE
AMERICAN CHEMICAL SOCIETY.
FOR THE YEAR 1885.

President,
J. C. BOOTH.

Vice-Presidents,

A. R. LEEDS,	ARNO BEHR,
A. A. BRENEMAN,	A. B. PRESCOTT,
H. ENDEMANN,	T. G. WORMLEY.

Corresponding Secretary,
P. CASAMAJOR.

Recording Secretary,
C. E. MUNSELL.

Treasurer,
T. O'C. SLOANE.

Librarian,
WILLIAM RUPP.

Curators,
A. C. HALE, F. V. POOL, M. LIEBSCHÜTZ.

Committee on Papers and Publications,
J. H. STEBBINS, JR., A. A. BRENEMAN, A. R. LEEDS.

Committee on Nominations,

J. B. MACKINTOSH,	J. P. BATTERSHALL,
A. EIMER,	H. M. RAU,

A. P. HALLOCK

Board of Directors,

A. R. LEEDS,
A. A. BRENEMAN,
H. ENDEMANN,
} *Three Local Vice-Presidents.*

P. CASAMAJOR,	J. H. STEBBINS, JR.,
C. E. MUNSELL,	E. WALLER,
T. O'C. SLOANE,	H. M. RAU,
WM. RUPP,	M. E. WALDSTEIN,
M. ALSBERG,	C. F. CHANDLER.

OFFICERS
OF THE
AMERICAN CHEMICAL SOCIETY.
FOR THE YEAR 1885.

President,
J. C. BOOTH.

Vice-Presidents,

A. R. LEEDS,	ARNO BEHR,
A. A. BRENEMAN,	A. B. PRESCOTT,
H. ENDEMANN,	T. G. WORMLEY.

Corresponding Secretary,
P. CASAMAJOR.

Recording Secretary,
C. E. MUNSELL.

Treasurer,
T. O'C. SLOANE.

Librarian,
WILLIAM RUPP.

Curators,
A. C. HALE, F. V. POOL, M. LIEBSCHÜTZ.

Committee on Papers and Publications,
J. H. STEBBINS, JR., A. A. BRENEMAN, A. R. LEEDS.

Committee on Nominations,

J. B. MACKINTOSH,	J. P. BATTERSHALL,
A. EIMER,	H. M. RAU,

A. P. HALLOCK

Board of Directors,

A. R. LEEDS,
A. A. BRENEMAN,
H. ENDEMANN,
} *Three Local Vice-Presidents.*

P. CASAMAJOR,	J. H. STEBBINS, JR.,
C. E. MUNSELL,	E. WALLER,
T. O'C. SLOANE,	H. M. RAU,
WM. RUPP,	M. E. WALDSTEIN,
M. ALSBERG,	C. F. CHANDLER.

PAST PRESIDENTS OF THE AMERICAN CHEMICAL SOCIETY.

*1876..J. W. DRAPER.	1881..C. F. CHANDLER.
*1877..J. LAWRENCE SMITH.	1882..J. W. MALLET.
1878..S. W. JOHNSON.	1883..J. C. BOOTH.
1879..T. STERRY HUNT.	1884.. " "
1880..F. A. GENTH.	1885.. " "

HONORARY MEMBERS.

BERTHELOT, M., College of France, Paris.
BOUTLEROW, A., University of St. Petersburg, St. Petersburg, Russia.
BUNSEN, R. W., University of Heidelburg, Germany.
CANNIZZARO, STANASLAS, Universita Instituto Chemico della Regio, Rome, Italy.
FRANKLAND, E., Royal College of Chemistry, South Kensington Museum, London, England.
WILLIAMSON, A. W., University College, London, W. C., England.
HOFMANN, A. W., 10 Dorothea Strasse, Berlin, Germany.
CHEVREUL, E., Académie des Sciences, Paris, France.

MEMBERS.

Life Members are marked †
Deceased Members are marked *

Adams, Isaac, Jr.....329 Broadway, N. Y.
Alsberg, M.....54 Maiden Lane, N. Y.
Amend, B. G.....205 Third Ave., N. Y.
Andrews, L. W.....Ames, Iowa.
Appleton, J. H.....Brown Univ., Providence, R. I.
Atwater, W. O.....Middletown, Conn.

Baker, W. H.....Freeport, Ill.
Barcena, Mariano.....Museo Nacional, City of Mexico, Mexico.
Bartey, E. H.....401 Pacific St., Brooklyn.
Battershall, J. P.....402 Washington St., N. Y.
Baujard, Edmund.....103 East 16th St., N. Y.
Baumgarten, F. M.....715 Shotwell St., San Francisco, Cal.
Beckwith, L. F.....229 Broadway, N. Y.
Bedford, P. W.....5-9 Beekman St., N. Y.
Behr, Arno.....75 Wabash Ave., Chicago, Ill.
Belcher, G. W.....St. Louis, Mo.
Blanpied, Benjamin.....Dartmouth Agricultural College, Hanover, N. H.
Booth, J. C.....U. S. Mint, Philadelphia, Pa.
Bragg, E. B.....Tremont Bank Building, Boston, Mass
Braschi, V. M.....23 Park Place, N. Y.
Breneman, A. A.....97 Water St., N. Y.
Brown, Wm. G.....Box 574, Ivy, Virginia.
Buck, C. Elton.....Wilmington, Del.

Calder, E. E.....Bd. of Trade Bg., R. 4, Providence, R. I.
Casamajor, P.....Havemeyers & Elder, Brooklyn, E. D., N. Y.
†Chandler, C. F.....School of Mines, N. Y.
Chase, Alonzo.....Ithaca, N. Y.
Chester, A. H.....Clinton, N. Y.
Colby, A. L.....Lehigh University, South Bethlehem, Pa.
Colby, C. E.....School of Mines, N. Y.
Conrad, C. P.....Fayetteville, Ark.
Corning, A. J.....Bolton & Mosher St., Baltimore, Md.
Cruse, E. F.....Johnstown, Pa.

De Schweinitz, E. A.....Salem, N. C.
Doremus, C. A.....92 Lexington Ave., N. Y.
Doscher, Henry.....142 Ross St., Brooklyn, N. Y.

*Draper, J. W.....New York.
*Du Motay, C. Tessie.....New York.
Dudley, C. B.....Altoona, Pa.
Dunnington, F. P.....University of Va., Albemarle Co., Va.

Eastwick, E. P.....Havemeyers Sugar Refining Co., Jersey City, N.J.
Ebert, A. E.....Peoria, Ill.
Eimer, August.....220 East 19th St., N. Y.
Eimer, Charles.....130 East 18th St., N. Y.
Einhorn, A.....10 Gramercy Park, N. Y.
Elliott, A. H.....School of Mines, N. Y.
Elliott, William.....197 Pearl St., N. Y.
Ellis, W. H.....Toronto, Canada.
Endemann, Hermann.....33 Nassau St., N. Y.
Engelhardt, C. F.....Syracuse Salt Co., Syracuse, N. Y.
Erhardt, C. F.....81 Maiden Lane, N. Y.

Fesquet, A. A.....1322 Marshall St., Philadelphia, Pa.
Fisher, R. A.....2239 St. Albans St., Philadelphia, Pa.
Freist, H. C.....724 Mifflin St., Philadelphia, Pa.
Friedburg, L. H.....40 East 10th St., N. Y.
Fristoe, E. T.....1434 N. St., N. W., Washington, D. C.

Gallatin, A. A.....University Building, N. Y.
Genth, F. A.....University of Pennsylvania, Philadelphia, Pa.
Gesner, G. W.....45 Cliff St., N. Y.
Geyer, W. E.....Stevens Institute, Hoboken, N. J.
Giessecke, Dr.....19 W. Swan St., Buffalo, N. Y.
Gladding, T. S.....55 Fulton St., N. Y.
Goessman, C. A.....Amherst, Mass.
Goldschmidt, S. A.....66 Water St., Brooklyn, N. Y.
Gordon, Antonio de.....Havana, Cuba.
Green, A. L.....Ann Arbor, Mich.
Green, Traill.....Easton, Pa.
Gregg, W. H.....27 South Oxford St., Brooklyn, N. Y.
Grovestein, M. W.....———
Grund, August.....121 Front St., N. Y.

Haas, H. L.....49 West 39th St., N. Y.
†Habirshaw, W. M.....159 Front St., N. Y.
Hale, A. C.....Box 65, Brooklyn, N. Y.
Hallock, A. P.....203 Rutledge St., Brooklyn, N. Y.
Hardin, M. B.....Virginia Military Institute, Lexington, Va.
Harmer, Thomas.....Nassau Bank, N. Y.
Harrison, T.....Philadelphia, Pa.
Hathaway, Nathaniel.....New Bedford, Mass.
†Havemeyer, H. C.....112 Wall St., N. Y.

Hazard, Herbert.....Caswell, Hazard & Co., 5th Avenue Hotel, N. Y.
Hedrick, B. S.....U. S. Patent Office, Washington, D. C.
Henes, W. F.....221 Randolph St., Chicago, Ill.
Herreshoff, J. B. F.....135 Clinton St., Brooklyn, N. Y.
Hill, N. P .....Denver, Col.
*Hill, W. M.....Chester, Delaware.
Hindley, R. D.....Racine College, Racine, Wis.
Hirschberg, Emil.....16 Dey St., N. Y.
Hofmann, J. A.....208 Montgomery St., San Francisco, Cal.
Homer, C. S.....323 Pearl St., N. Y.
Hopke, T. M.....197 Pearl St., N. Y.
Humphrey, H. C.....34 Dey St., New York.
Howe, J. L.....Central University, Richmond, Ky.
†Hunt, T. S.....33 Durocher St., Montreal, Canada.

Jenks, O. M.....515 Franklin St , Philadelphia, Pa.
Johnson, S. W.....New Haven, Conn.

Kelly, J. F.....273 Bloomfield St., Hoboken, N. J.
Kent, W. H.....Board of Health, Brooklyn, N. Y.
Kersting, Hermann.....15 Kilby St , Boston, Mass.
Koenig, G. A.....University of Pennsylvania, Philadelphia, Pa.
*Krackowitzer, S.....New York.
Krause, G.....Chemiker Zeitung, Coethen, Germany.
Krause, O. H..... ..Box 217, Jersey City, N. J.

Lawver, W. P.....Treasury Dept., Washington, D. C.
Lawler, C. J.....Cor. Morton St. & Kent Ave., Brooklyn, E. D. N. Y.
Lecour, E. H.....547 West 18th St., N. Y.
Ledoux, A. R.....10 Cedar St., N. Y.
Lee, C. T.....45 Kilby St., Boston, Mass.
Leeds, A. R.....Stevens Institute, Hoboken, N. J
Lees, W. T.....N. Y. Gas Light Co., Ave. A and 21st St., N. Y.
Lehmann, G. W.....57 S. Gay St., Baltimore, Md.
Leman, W. L.....305 West 55th St., N. Y.
Liebig, G. A.....87 Exchange Place, Baltimore, Md.
Liebschutz, Morton.....345 West 34th St., N. Y.
Lillie, S M.....307 Pine St., Philadelphia, Pa.
*Lipps, J. S.....New York.
Lindsley, J. Berrien.....Nashville, Tenn.
Lillie Joseph.....Passaic, N. J., Dundee Chem. Works.
Lungwitz, Theodore.....Chic. Sug. Ref. Co., Taylor and Beach Sts., Chicago, Ill.
Lupton, N. T... .....Vanderbilt University, Nashville, Tenn.
Luthy, Otto.....220 Church St., Philadelphia, Pa.

Mackintosh, J. B.....55 Garden St., Hoboken, N. J.
Mason, W. P.....Rensselaer Pol. Inst., Troy, N. Y.
McKenna, C. F.....216 East 19th St., N. Y.
*McIntire, H. M.....Easton, Pa.
Maisch, John M.....College of Pharmacy, Philadelphia, Pa.
Mallett, J. W.....Univ. of Va., Albemarle Co., Va.
Martyn, Henry, Sec'y.....Middlebury College, Vermont.
Martius, R. A.....Actien Geselschaft für Anilin Fabrication, Berlin, Germany.
Mattison, J. G.....197 Pearl St., N. Y.
Mew, Wm. M.....422 5th St., Washington, D. C.
Miller, G M.....Ringwood, N. J.
Moore, G. E.....69 Liberty St., N. Y.
Moore, R. W.....School of Mines, Columbia College, N. Y.
Morgan, T. M.....Compton, R. I.
Morrell, Thos. T.....Cambria Iron Works, Johnstown, Pa.
Morton, Henry.....Stevens Institute, Hoboken, N. J.
Mott, H. A., Jr.....23 Park Row, N. Y.
Munroe, C. E.....U. S. Naval Academy, Annapolis, Md.
Munsell, C. E.....115 East 10th St., N. Y.

Nason, H. B.....Troy, N. Y.
Nichols, W. H.....41 Cedar St., N. Y.
Niese, H. E.....Matthiessen & Wiechers, Jersey City, N. Y.

O'Connor, T. D.....12 E. 44th St. N. Y.
Orth, A.....F. Bredt & Co., 194 Fulton St., N. Y.

Pearce, Richard.....Denver, Col.
Perkins, G. E.....Providence, R. I.
Peters, Andrew.....9th St., and Gowanus Canal, Brooklyn, N. Y.
*Peters, J. A.....New York.
Phelps, Geo. N.....127 First Place, Brooklyn, N. Y.
*Picabia, V. M.....New York.
Pickhardt, Carl.....98 Liberty St., N. Y.
Pigeon, Narcisse.....Yonkers, N. Y.
Pirz, Antony.....Long Island City, N. Y.
Pitkin, Lucius.....432 Madison Ave., N. Y.
Pool, F. V.....191 Roseville Ave., Newark, N. J.
Prescott, A. B.....Ann Arbor, Mich.
Prochazka, Geo. A.....160 East 79th St., N. Y.

Radenhausen, P.....Davenport Glucose Co., Davenport, Iowa.
Rau, H. M.....Hanover, York Co., Pa.
Redwood, Boverton.....85 Gracechurch St., London, England.
Remsen, R. G.....1722 Walnut St., Philadelphia, Pa.
Ricketts, P. de P.....School of Mines, N. Y.

Robbins, C. A.....91 Fulton St., N. Y.
Roberts, W. C.....Royal Mint, London, Eng.
Rossi, A. J.....69 East 11th St., N. Y.
Rupp, William.....117 Pearl St., N.Y.

Schank, J. S.....Princeton College, Princeton, N. J.
*Schmich, C. W.....Orbisonia, Pa.
Schultz, C. H.....Cor. 17th St. and Broadway, N. Y.

Seaman, H. J.....Crane Iron Co., Catasauka, Pa.
Seeley, H. M.....Middlebury, Vt.
Shapleigh, Waldron.....362, Produce Exchange.
Sharpless, S. P.....12 Broad St., Boston, Mass.
Shepard, C. U.....46 Meeting St., Charleston, S. C.
Silliman, Benjamin.....New Haven, Conn.
Simon, William.....10 Block St., Baltimore, Md.
Slade, J. F.....135 Madison Ave., N. Y.
Sloan, T. O'C.....119 Pearl St., N. Y.
Smith, Hanbury.....35 Union Square, N. Y.
Smith, W. F.....235 Washington St., Boston.
Squibb, E. R.....36 Doughty St., Brooklyn N. Y.
*St. John, S. M.....New York.
Stebbins, J. H., Jr.....117 Pearl St., New York.
Sticht, J. C.....81 Maiden Lane, N. Y.
Stillwell, C. M.....55 Fulton St., N. Y.
Strattford, W.....109 East 15th St., N. Y.
Sustersic, Ferdinand.....Big Springs, Texas.

Terne, Bruno.....1429 S. 6th St., Philadelphia, Pa.
Thomsen, A. L.....52 Sharp St., Baltimore, Md.
Tonelé, Theodore.....McKeesport, Pa.
Tucker, J. H.....225 Church St., Philadelphia, Pa.
Tucker, W. G.....4 Lancaster St., Albany, N. Y.

Van Sinderen, A. H.....45 William St., N. Y
Van Slooten, William.....683 Broadway, N. Y.
Vaughn, H. W.....Providence R. I.
Venable, F. P.....Chapel Hill, N. C.
Volney, C. W.....Toms River, N. J.
Von Mueller, Ferdinand...Melbourne, Australia.

Wainwright, J. H.....422 Washington St., New York.
Wait, C. E.....Missouri School of Mines, Rolla, Mo.
Waldstein, M. E..... 92 New Church St., N. Y.

†Waller, Elwyn.....School of Mines, N. Y,
Walsh, F. T.....Box 252, Lowell, Mass.
Ware, L. S.....810 Walnut St., Philadelphia, Pa.
Weber, Henry A.....State University, Columbus, Ohio.
Wendt, C. J.....81 Maiden Lane, N. Y.
Wenzell, W. T.....852 Market St., San Francisco, Cal.
Wheeler, C. G.....81 Clark St., Chicago, Ill.
Williams J. T.....Cotton Exchange, N. Y.
Williams, S. W.....72 William St., N. Y.
Witthaus, R. A.....830 Main St., Buffalo, N. Y.
Wittmack, C. A.....P. O. Box 1032, N. Y.
Wittman, B. N.....Pittsburgh Steel Casting Co., Pittsburgh, Pa.
Wolf, T. R.....Delaware College, Newark, Delaware.
Wood, M. R.....35 Ash St., Brooklyn.
Wormley, T. G.....University of Pennsylvania, Philadelphia, Pa.

Youmans, W. J.....Care D. Appleton & Co., 1 Bond St., N. Y.

ASSOCIATE MEMBERS.

Adler, J.....743 Lexington Ave., N. Y.

Binns, Joseph.....Cor. Pearl and Cedar Sts., N. Y.
Booraem, J. V. V.....N. 3d and 1st Sts., Brooklyn, E. D., N. Y.
Braker, Conrad, Jr.....215 Pearl St., N. Y.
Bower, Henry.....P. O. Box 2315, Philadelphia, Pa.

Cochrane, Alexander.....55 Kilby St., Boston, Mass.
Cochrane, Hugh.....55 Kilby St., Boston, Mass.

Day, Austin G.....120 Broadway, N. Y.
Dickerson, E. N.....Temple Court, Beekman St., N. Y.
Donner, J. O.....Cor. N. 3d and 1st Sts., Brooklyn, E. D., N. Y.

Dunham, E. K.....93 Boylston St., Boston Mass.

Elder, F. H.....117 Wall St., N. Y.
Elder, G. H.....770 Madison Ave., N. Y.
Elmerhorst, W. R.....St. Lawrence Sugar Refining Co., Montreal, Canada.

Harding, G.....237 Broadway, N. Y.
Havemeyer, C. W.....112 Wall St., N. Y.
Havemeyer, H. O.....117 Wall St., N. Y.
†Havemeyer, T. O.....117 Wall St., N. Y.
Heinitsh, C. A.....16 East King St., Lancaster, Pa.
Heller, Fred.....55 Maiden Lane, N. Y.
Holly, J. J.....63 Beaver St., N. Y.

†Kuttroff, Adolph.....98 Liberty St., N. Y.

Lennig, Charles.....112 S. Front St., Philadelphia, Pa.

Mapes, C. V.....158 Front St., N. Y.
Matthiessen, F. O.....106 Wall St., N. Y.
Meyer, H. C.....140 William St., N. Y.
Merz, Henry.....55 Maiden Lane, N. Y.

Nichols, G. H.....41 Cedar St., N. Y.

Page, G. S.....49 Wall St., N. Y.
†Pickhard, Wilhelm.....98 Liberty St., N. Y.

Plympton, G. M.....245 Broadway, N. Y.
Polledo, G.....40 Stuyvesant St., N. Y.
†Prentice, W. P.....301 Mott St., N. Y.

Renwick, E. S.....16 Murray St., N. Y.
Rudesch, J.....117 East 59th St., N. Y.

†Senff, C. H.....117 Wall St., N. Y.
Sieghortner, A. L.....Care Belcher Sugar Ref. Co., St. Louis, Mo.
Stursberg, J. A.....Brooklyn Sugar Refinery, foot S. 2d. St., Brooklyn, N. Y.

Weston, E. D.....118 Wabash Ave., Chicago, Ill.
Williamson, D. D.....11 Dey St., N. Y.